Montana Department or Transporation

Rockfall Hazard Process Assessment

State of Montana

RFP No. 15-3059V

LANDSLIDE TECHNOLOGY
A DIVISION OF CORNFORTH CONSULTANTS

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March 10, 2015 P-1225

Rick Dorvall, Procurement Officer
State Procurement Bureau
General Services Division
Department of Administration
Room 165, Mitchell Building
125 North Roberts Street
Helena, MT 59601-4558

RFP Number: 15-3059V
Rockfall Hazard Rating Process Assessment
Montana Department of Transportation

Dear Mr. Dorvall:

Landslide Technology is pleased to present this proposal for the Rockfall Hazard Rating Process Assessment as outlined in Montana Department of Transportation RFP No. 15-3059V. We are an engineering consulting firm that specializes in geotechnical engineering and geological services. The firm is in its 31st year of operations and has developed a very strong base of clients in both private and public sectors. We have conducted hundreds of rockfall evaluation and mitigation projects in the northwest including many for the Montana Department of Transportation (MDT). One of these projects includes the original modification and implementation of the Rockfall Hazard Rating System (RHRS) for MDT beginning in 2003. Since that time, Landslide Technology has continued to provide technical services to MDT on a wide range of rockfall evaluation and mitigation projects including two of our most recent projects: the current I-15 (D3) final rockfall mitigation design from Helena to Great Falls, and the emergency rockfall evaluation and response at four sites on I-90 west of St. Regis.

In the performance of this solicitation for the Rockfall Hazard Rating Process Assessment, Landslide Technology, as the Prime Consultant, would lead a team of national leaders in the creation of rockfall evaluation management programs that would integrate into state DOT's Transportation Asset Management Plans.

Landslide Technology (LT) offers the following benefits to MDT for the performance of this project.

- Intimate knowledge of MDT's existing Rockfall Hazard Rating System (RHRS) and rock slope conditions through our previous performance of personally evaluating approximately 90% of MDT's rock slopes.

- Team expertise with developing and expanding on RHRS principles and systems for compatibility with other state DOT Transportation Asset Management plans.
- The participation of Darren Beckstrand, C.E.G., current research lead for the development of a Geotechnical Asset Management System for the Alaska Department of Transportation, including rock slopes, unstable soil slopes and embankments, retaining walls, and DOT-owned material source. Mr. Beckstrand was a key team member of the original RHRS implementation for MDT, personally evaluating over 600 rock slopes.
- The participation of Brent Black, C.E.G., who has led dozens of rock mitigation evaluations and design projects throughout Montana. This experience has provided Mr. Black with extensive first-hand knowledge of the rockfall issues and challenges faced by MDT. Mr. Black was also a key team member of the original RHRS implementation for MDT, personally developing mitigation cost estimates for the 100 highest rated rock slopes in Montana.
- Senior peer review and consultation by Lawrence Pierson, C.E.G., the principal researcher and developer of the RHRS. Mr. Pierson was the Project manager for the 2003-2005 MDT RHRS implementation.
- Involvement from Paul Thompson, a nationally recognized leader in Transportation Asset Management (TAM) Plans and integration of life-cycle cost-benefit analyses for project programming and planning.
- Participation of David Stanley, C.P.G., recently retired Chief Geologist for the AKDOT&PF with extensive experience in developing rockfall evaluation programs compatible with statewide TAM plans.
- The experience of GCS (Geographic Communication Systems) of Missoula, Montana for the evaluation of MDT's rockfall program IT infrastructure and its integration into its IT and database systems.

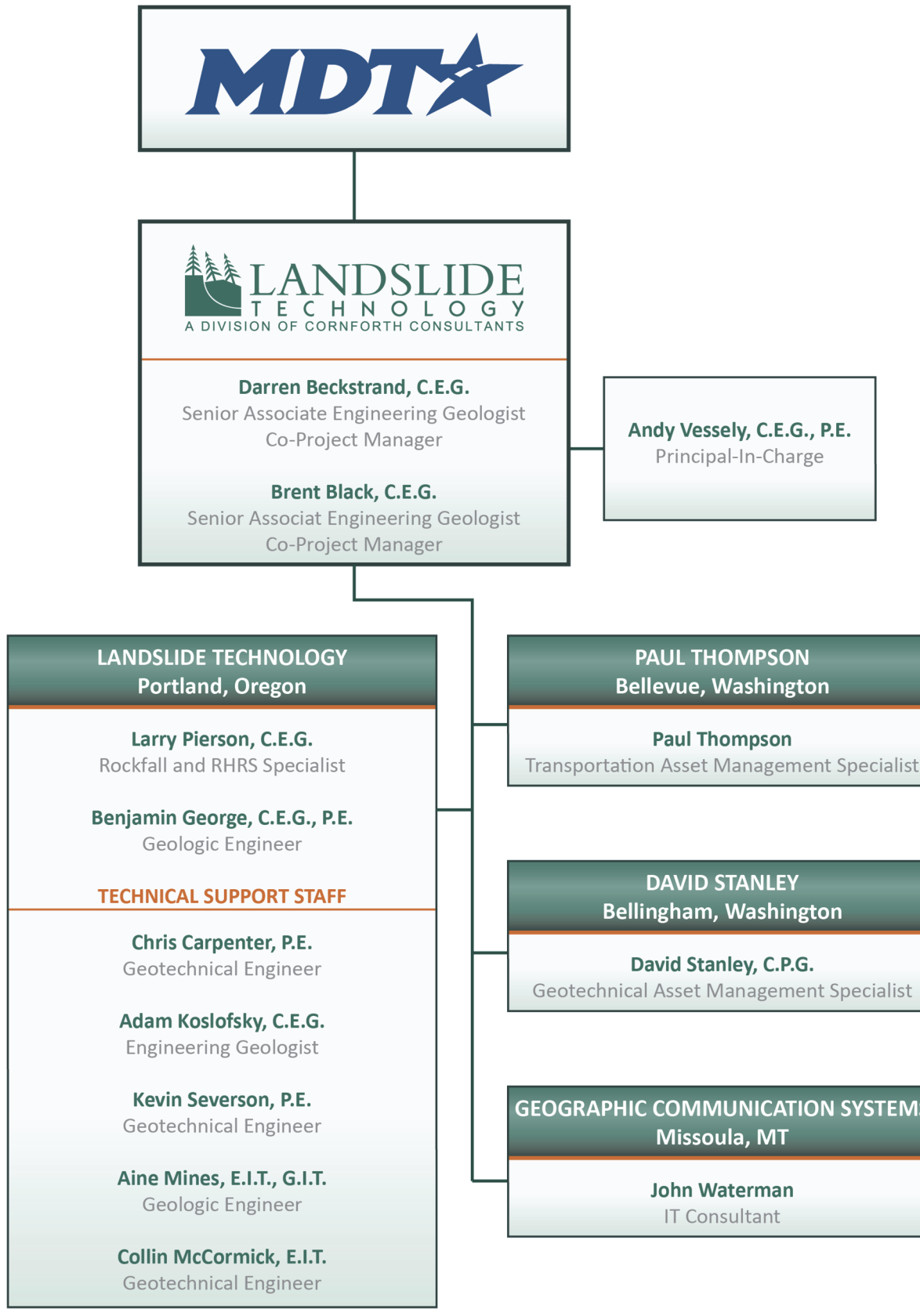
As stipulated, our proposal is organized in accordance with the RFP. It addresses the Department's requirements, issues and needs, as augmented by Addendum #1 issued February 24, 2015. The cost estimate is provided as a two-year plan in Section 5.

We are confident that our team can provide a valuable service in this important assignment for the Montana Department of Transportation. We look forward to the opportunity to provide these services.

Sincerely,

LANDSLIDE TECHNOLOGY

Andy Vessely, P.E., C.E.G
President


MDT
LANDSLIDE TECHNOLOGY
A DIVISION OF CORNFORTH CONSULTANTS
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Co-Project Manager
Brent Black, C.E.G.
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Co-Project Manager
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Principal-In-Charge
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Rockfall and RHRS Specialist
Benjamin George, C.E.G., P.E.
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Chris Carpenter, P.E.
Geotechnical Engineer
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Engineering Geologist
Kevin Severson, P.E.
Geotechnical Engineer
Aine Mines, E.I.T., G.I.T.
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Collin McCormick, E.I.T.
Geotechnical Engineer
PAUL THOMPSON
Bellevue, Washington
Paul Thompson
Transportation Asset Management Specialist
DAVID STANLEY
Bellingham, Washington
David Stanley, C.P.G.
Geotechnical Asset Management Specialist
GEOGRAPHIC COMMUNICATION SYSTEMS
Missoula, MT
John Waterman
IT Consultant

STATE OF MONTANA
REQUEST FOR PROPOSAL (RFP)

RFP Number: 15-3059V	RFP Title: ROCKFALL HAZARD RATING PROCESS ASSESSMENT	
RFP Response Due Date and Time: March 10, 2015 2:00 p.m., Mountain Time	Number of Pages: 49	Issue Date: February 3, 2015

ISSUING AGENCY INFORMATION

Procurement Officer: Rick Dorvall	State Procurement Bureau General Services Division Department of Administration Phone: (406) 444-2575 Fax: (406) 444-2529 TTY Users, Dial 711
Website: http://vendor.mt.gov/	

INSTRUCTIONS TO OFFERORS

Return Sealed Proposal to:

PHYSICAL ADDRESS:
State Procurement Bureau
General Services Division
Department of Administration
Room 165, Mitchell Building
125 North Roberts Street
Helena, MT 59601-4558

MAILING ADDRESS:
State Procurement Bureau
General Services Division
Department of Administration
P.O. Box 200135
Helena, MT 59620-0135

Mark Face of Envelope/Package with:

RFP Number: 15-3059V
RFP Response Due Date: March 10, 2015

Special Instructions:

OFFERORS MUST COMPLETE THE FOLLOWING

Offeror Name/Address:

Landslide Technology
10250 SW Greenburg Rd Suite 111
Portland, Oregon 97223

Andy Vessely, President
(Name/Title)

(Signature)

Print name and title and sign in ink. By submitting a response to this RFP, Offeror acknowledges it understands and will comply with the RFP specifications and requirements.

Type of Entity (e.g., corporation, LLC, etc.)	Offeror Phone Number:
Corporation	503-452-1200
Offeror E-mail Address:	**Offeror FAX Number:**
andyv@landslidetechnology.com	503-452-1528

OFFERORS MUST RETURN THIS COVER SHEET WITH RFP RESPONSE

DEPARTMENT OF ADMINISTRATION
GENERAL SERVICES DIVISION
STATE PROCUREMENT BUREAU
http://gsd.mt.gov/

STEVE BULLOCK
GOVERNOR

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HELENA, MONTANA 59620-0135

FEBRUARY 24, 2015

STATE OF MONTANA
REQUEST FOR PROPOSAL ADDENDUM
RFP NO. 15-3059V
TO BE OPENED: MARCH 10, 2015
TITLE: ROCKFALL HAZARD RATING PROCESS ASSESSMENT

ADDENDUM NO. 1

To All Bidders:

Attached are written questions received in response to this RFP. These questions, along with the State's response, become an official amendment to this RFP.

All other terms of the subject "Request for Proposal" are to remain as previously stated.

Acknowledgment of Addendum:

The offeror for this solicitation must acknowledge receipt of this addendum. This page must be submitted at the time set for the proposal opening or the proposal may be disqualified from further consideration.

I acknowledge receipt of Addendum No. 1

Signed: Andy Vessel

Company Name: Landslide Technology

Date: 3/6/15

Sincerely,

Rick Dorvall
Contracts Officer

ACKNOWLEDGEMENT OF SPECIFIC SECTIONS AND SUBSECTIONS

Landslide Technology acknowledges that we have read, understand, and will comply with each section/subsection as listed below as indicated by initialing. All other sections not listed below require a detailed response.

AV	Section 1, Introduction and Instructions
AV	Section 2, RFP Standard Information
AV	Section 4.1, State's Right to Investigate and Reject
AV	Section 5.2, Project Funding
AV	Section 5.3, Budget Revisions
AV	Section 6, Evaluation Process
AV	Appendix A, Contract
AV	Appendix D, Nondiscrimination and Disability Accommodation Notice
AV	Appendix E, Technical Report Documentation Page

Landslide Technology understands and will comply with Appendix B, Proof of Authority upon the State's request.

3.1 Introduction

- Work Plan
- Detailed Schedule
- Assistance From MDT

3 SCOPE OF SERVICES

The Landslide Technology Team includes a number of professionals that have evaluated hundreds of rock slopes and worked with a variety of states to generate both Geotechnical and/or Transportation Asset Management (GAM or TAM) plans. We understand that each subsection of Section 3 requires a detailed written response thoroughly addressing each item and major task to accomplish the contract requirements. However, based on our aforementioned experience, additional opportunities for this project to better conform to a TAM are described in our responses. These Optional Tasks are clearly marked as optional and are not included in the price proposal. Furthermore, we do not take exception to any RFP requirements detailed in Section 3.

3.1 INTRODUCTION

Our Team's understanding of the project's background and objectives and our approach to accomplish the Contract requirements are contained under the specific subheading sections as specified in the RFP. In this section, our Work Plan, proposed project schedule, and requested interaction from MDT are introduced with other required responses contained in other relevant sections.

WORK PLAN

Our proposed Work Plan follows the organization of the RFP document with tasks outlined according to the tasks outlined in Section 3.4. Where optional tasks are proposed, they are clearly labeled as optional. The methods used to accomplish the contract requirements are provided in each response.

Our Management team has attended the MDT-sponsored Earned Value Project Management training seminar and is familiar with MDTs invoicing and monthly summary procedures.

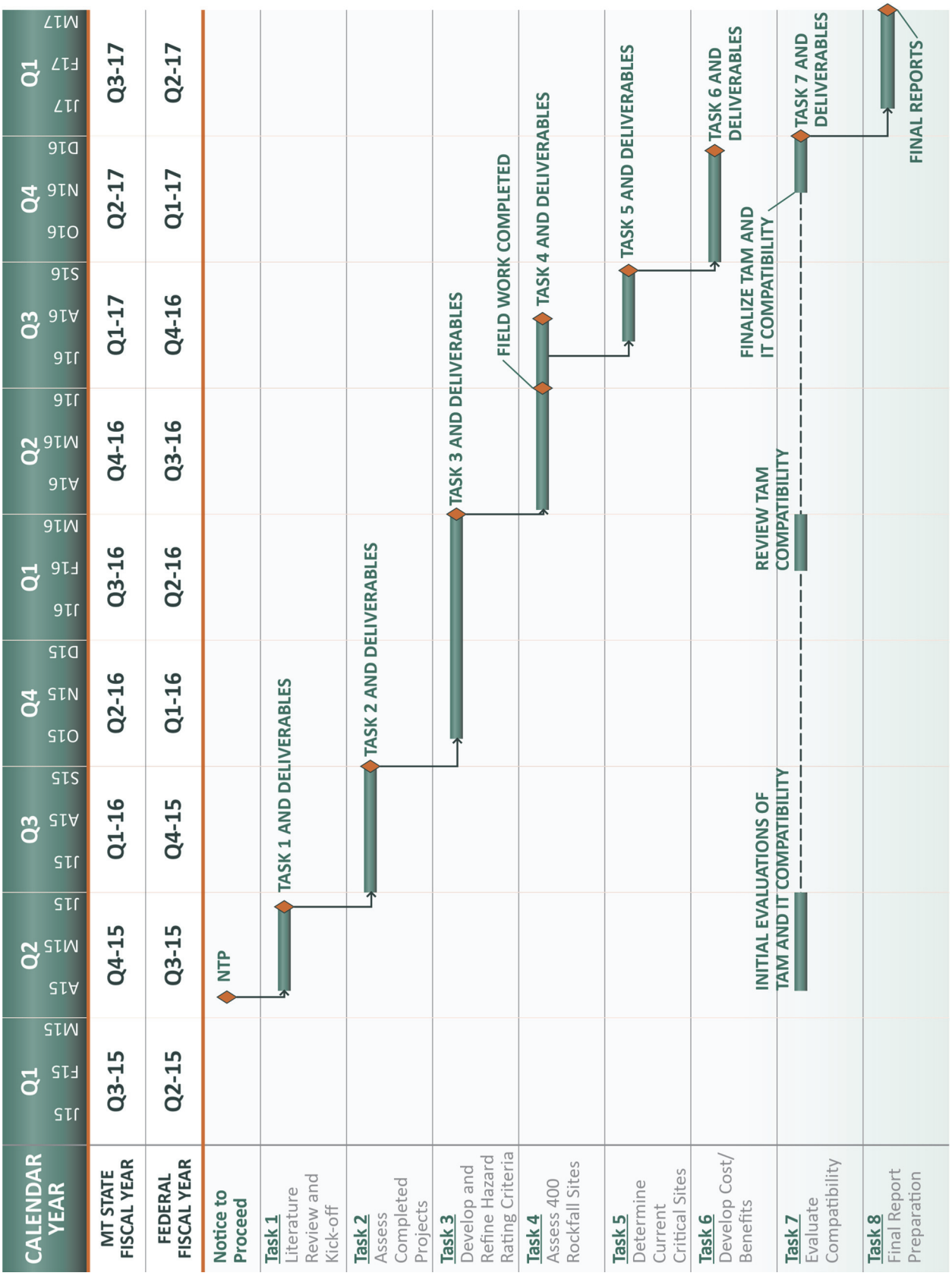
To ensure high-quality project deliverables, we have assembled a highly-qualified team of experienced professionals and each deliverable would be peer-reviewed by project participants for concise, accurate communication of the Team's concepts, procedures and recommendations.

Regular communication between LT and MDT is critical to the project's success. We would provide monthly updates for the tracking of task progress, budget and task tracking, and interactions with MDT and our Subconsultants. If needed, collaborative project management software would be employed to facilitate sharing of documents, schedules, and tasks both within the LT Team and with MDT.

DETAILED SCHEDULE

Landslide Technology conducts its operations with the goal to produce quality work under strict time constraints. Our consulting team is committing our resources and each of the Key Staff personnel listed to meet the schedules described within this section. An updated schedule would be maintained during the project and submitted with progress reports.

We propose a two year project schedule to accomplish the tasks defined in the RFP. The previous RHRS implementation required a three-year schedule with two seasons of fieldwork to perform the preliminary ratings and then a second summer season to perform the detailed ratings. Since a preliminary rating phase is not needed for this project, a schedule following a two-year project duration, following the required tasks outlined in Section 3.4 is proposed and shown below.


CALENDAR YEAR
MT STATE FISCAL YEAR
FEDERAL FISCAL YEAR
Q1 J15 F15 M15
Q2 A15 M15 J15
Q3 J15 A15 S15
Q4 O15 N15 D15
Q1 J16 F16 M16
Q2 A16 M16 J16
Q3 J16 A16 S16
Q4 O16 N16 D16
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Q1-16
Q3-16
Q2-16
Q4-16
Q3-16
Q1-17
Q4-16
Q2-17
Q1-17
Q3-17
Q2-17
Notice to Proceed
NTP
Task 1 Literature Review and Kick-off
TASK 1 AND DELIVERABLES
Task 2 Assess Completed Projects
TASK 2 AND DELIVERABLES
Task 3 Develop and Refine Hazard Rating Criteria
TASK 3 AND DELIVERABLES
FIELD WORK COMPLETED
Task 4 Assess 400 Rockfall Sites
TASK 4 AND DELIVERABLES
Task 5 Determine Current Critical Sites
TASK 5 AND DELIVERABLES
Task 6 Develop Cost/ Benefits
TASK 6 AND DELIVERABLES
FINALIZE TAM AND IT COMPATIBILITY
Task 7 Evaluate Compatibility
TASK 7 AND DELIVERABLES
REVIEW TAM COMPATIBILITY
INITIAL EVALUATIONS OF TAM AND IT COMPATIBILITY
Task 8 Final Report Preparation
FINAL REPORTS

ASSISTANCE REQUIRED FROM MDT

A collaborative effort between the LT team and various sections within MDT is a critical component of a successful outcome. In order to achieve this, close interaction with MDT geotechnical staff is a priority. Also important is our interaction with MDT Maintenance personnel that would provide the detailed history of the statewide rockfall activity, the demands this places on the Maintenance Districts, and perspectives on slope degradation that are all critical aspects for project success. We would also need to interact with MDT staff that is generating the draft TAM plan so that our products would integrate seamlessly with their efforts and prevent duplication of efforts. Finally, our team member, GCS, would need to work closely with MDT IT staff to assure database structure compatibility.

The timeframe for establishing interaction with MDT's geotechnical staff would be soon after Notice-to-Proceed is given. Some Maintenance interaction would be required early in the performance of the contract to alert them of the project and so Maintenance Supervisors can schedule time for onsite reviews with key maintenance personnel and our field representatives (technical support staff) to document rockfall history and maintenance information.

LT strives to complete all work assignments with a high degree of professionalism and work product quality. Established QA/QC policies would be practiced through all portions of project development, and at all levels. In addition to the communication and QA/QC requirements stated in the RFP, our team would follow the Project Quality Objectives outlined in Chapter 9 of MDT's Consultant Services Manual.

3.2 Scope And Objectives

- Project Understanding

3.2 SCOPE AND OBJECTIVES

PROJECT UNDERSTANDING

MDT has been using the Oracle RHRS database for about ten years. In that time, it has proved very useful to the Department in providing an easily assessable source of rock slope information for both project planning, background information, and for detailed historic photos in emergency situations. MDT has become more adept at utilizing the information while at the same time addressing an increasing number of rockfall problems as the State's highway system matures and the highway cut slopes continue to age and deteriorate. This ongoing deterioration is not addressed in the current RHRS database since re-ratings have not been performed. As a result, rockfall evaluations need to be updated for approximately 400 slopes, including both degraded and mitigated slopes.

Updated rock slope management information, in conjunction with MAP-21 recommendations, is needed to implement TAM plans. This provides an excellent opportunity for MDT to review and revise their rockfall evaluation and project selection process to ensure compatibility with future agency TAM plans as they are developed.

To leverage newer IT technologies, particularly geographic information systems (GIS) mapping and potentially mobile and cloud-based computing to manage data, LT has enlisted the participation of Missoula-based Geographic Communication Systems.

We have identified four primary objectives for this project:

1) Update the rating criteria and slope evaluations primarily for the "A-rated" RHRS slopes, with an emphasis on those slopes where rockfall mitigations have been performed and on slopes that appear to have deteriorated (such as those on I-90 between Lookout Pass and St. Regis). Rating criteria would be updated to include both condition and risk assessments compatible with current state of the practice and future TAM plans.
2) Determine current critical sites and groupings of sites in order to create a selection process and prioritize potential rockfall construction projects suitable for long-range planning strategies.
3) Develop cost/benefit scenarios to include safety considerations, highway use, and maintenance components to help prioritize the State's most critical sites.
4) Evaluate the compatibility of the current rockfall hazard evaluation process with regard to a future TAM plan and IT requirements.

A detailed summary of how we plan to accomplish these objectives is contained in our response in Section 3.4.

3.3 Problem Statement, Background Summary, Benefits/ Business Case

- Problem Statement
- Background Summary and Preliminary Literature Review
- Business Case

3.3 PROBLEM STATEMENT, BACKGROUND SUMMARY AND BENEFITS/BUSINESS CASE

For scoring and evaluation purposes, please refer to Sections 3.1 through 3.3 for descriptions of our Approach, Scope and Method of Services and Section 4 for our Staffing Approach.

PROBLEM STATEMENT

MDT seeks to provide a rock slope management system that emphasizes quality, safety, and cost effectiveness through proactive condition and risk assessments coupled with properly timed interventions to reduce impacts to the Department and the Public.

The current inventory system has not been updated since implementation 10 years ago, limiting effective management of roughly 400 rockfall sites, particularly those in the western half of the State. The 25-year-old RHRS evaluation methodologies, the current data storage IT infrastructure, and the potential compatibility with future TAM plans all need to be evaluated. Current site data needs to be updated and the rock slope management program needs to be reviewed to fulfill MDTs mission to provide systems and services that stress quality, safety, cost effectiveness and economic vitality to Montana.

BACKGROUND SUMMARY AND PRELIMINARY LITERATURE REVIEW

The Montana Department of Transportation has prepared a Request for Proposal titled Rockfall Hazard Rating Process Assessment (RFP No. 15-3059V). MDT's objective is to obtain an evaluation of the existing rockfall hazard rating process and recommend updates as necessary for a more effective asset management system for their rock slopes. The updates are intended to be used as a planning device to provide guidance to MDT on selection and advancement of rockfall mitigation projects. This guidance would be used by MDT geotechnical staff as decision support tools to advance appropriate projects to the design and construction phases, either on a District or Statewide level.

The previous rockfall management project implemented the nationally and internationally utilized Rockfall Hazard Rating System (RHRS), with only minor adjustments to the climate categories. Implementing the RHRS consisted of visiting 2,653 rockfall sites; and performing detailed ratings, where 13 criteria are evaluated, at 869 of those sites. Of these detailed rating sites, a score cutoff of 350 points (on a total possible scale of 1,100 points) was established to define highest-hazard, or A-rated sites. This resulted in a total of 368 A-rated sites on the evaluated MDT highway system.

Following this rating effort, conceptual designs and costs estimates were formulated for the highest-rated 100 slopes. These cost estimates (which did not include items such as PS&E, traffic control, etc.) were used to calculate cost to RHRS score ratios to optimize investments at the higher rated slopes.

Based on a preliminary literature review, the most widely used rockfall ranking and management systems in North America are variations or modifications of the Rockfall Hazard Rating System, developed in 1993 (FHWA Publication No. FHWA SA-93-057). Other similar hazards rating systems, such as those for landslides, use a similar exponential scoring system as found in the RHRS (Liang, 2007). The DOTs of New York, Ohio, Utah, Washington, Alaska, Tennessee, and Missouri are all examples of agencies that along with

MDT have utilized RHRS-based systems for ranking and evaluating rock slopes. In a 2008 survey (TRB, 2012), 25 U.S. State or Canadian Provincial transportation agencies utilize a management system to track rock slope data and most of these (88%) are based on the RHRS. Most of these agencies have made modifications to the RHRS to meet departmental goals and objectives, such as Montana's relatively minor modification for climatic criteria.

Since these implementations, the process to inventory and assess slope condition and risks has begun to advance into a more complete geotechnical asset management system. This maturation has been partially driven by the Moving Ahead for Progress in the 21st Century Act, or MAP-21, signed into law in July 2012. This Act requires a streamlined and performance-based surface transportation program for bridges and pavements and encourages similar management practices for other types of transportation assets.

The recent shift in rockfall management has been in response to MAP-21, with a focus on a risk-based asset management approach. The goals of this current RFP fit nicely with the objectives of MAP-21 in creating an asset management program to prioritize and program rock slope mitigation projects, eventually based on life-cycle cost analysis and supportive condition and deterioration driven analytics.

The MDT Strategic Business Plan summarizes the Department's major goals, which are resolved into policies and actions in Tranplan21 (MDT's Long-Range Transportation Plan). Among the major goals in the Strategic Business Plan are:

Ensure investment decisions consider policy directions, customer input, available resources, system performance, and funding levels.

Enhance traveler mobility by providing a safe and efficient multimodal transportation system that supports Montana's economy and is sensitive to the environment.

Reduce fatal and injury crash rates.

Continuously strive to improve the effectiveness and efficiency of operations and processes.

Consistently communicate standards, guidelines, policies, and expectations throughout MDT.

At the federal level, the same goals are expressed in MAP-21 in 23 USC 150(b) as amended. State Departments of Transportation are required to describe and quantify their strategies, targets, and progress in pursuing these goals by means of performance measures and the Risk-Based Transportation Asset Management Plan (TAM Plan). Although only National Highway System (NHS) pavements and bridges are required to be covered by the TAM Plan, 23 USC 119(e)(3) encourages states to include all infrastructure assets within the right-of-way corridor and to include non-NHS roadways as much as practicable.

In response to MAP-21, the Federal Highway Administration has drafted a set of rules for Risk-Based Transportation Asset Management Plans. The proposed rules clarify that the life cycle cost analysis and investment analysis mandated within the TAM Plan should be risk-based, meaning that it accounts for the strategies and costs of managing risks to the performance of the transportation system, including any aspects of performance listed in 23 USC 150(b).

BUSINESS CASE

Rock slopes are a class of assets that affect the safety, mobility, and efficiency of Department operations and processes by means of the risk posed by rockfall. DOTs routinely expend scarce resources to clear fallen rocks from roads, to recover from rock-vehicle collisions, to scale loose rock before it falls, and to install and maintain mitigation measures such as catchment ditches, barriers, and fences. The ultimate purpose of these activities is to satisfy Department goals for safety, mobility, and efficiency as well as the utility of the system.

With the aid of a comprehensive inventory, condition assessments, and other supporting studies that are not part of this study (e.g. deterioration modelling, establishment of detailed rockfall-related maintenance costs, accident data that accurately reflect when rockfall was a causative factor, etc.) MDT would be able to perform the same types of analyses for rock slope assets as they currently perform for pavements and bridges. Within the TAM Plan process:

- They would be able to use condition and work history data to develop forecasting deterioration models and costs utilizing the methods outlined in NCHRP Report 713;
- Using the methods documented in NCHRP Report 483, they would be able to compute reasonable estimates of life cycle cost that take into account both near- and long-term forecasts of maintenance and capital investments in order to promote efficiency by minimizing these costs, using methods such as those documented in NCHRP Report 483.
- They would be able to quantify safety and mobility impacts related to rockfall using research-based methods under development for the Alaska DOT based on the standard AASHTO Red Book.
- They would be able to compute the return on investment of preservation work. In asset management for pavements and bridges, where feasible preservation projects exist, it is common for preservation work to have a return on investment of 50% (i.e. each investment of $1 will save $1.50 in life cycle costs). This return can be increased to 100% or more when the costs related to safety and mobility benefits are included.
- They would be able to perform a fiscally-constrained investment analysis for the TAM Plan, satisfying federal requirements by incorporating funding uncertainty, and enabling the development of reasonable performance targets and expectations to fit a given funding level.

All of these are important elements for the inclusion of rock slopes in the TAM Plan, according to the proposed federal rule, and they are also needed for inclusion in MDT's Performance Programming Process (P3). These capabilities are dependent on a consistent, objective assessment of rock slope condition as proposed in this study.

By implementing an enhanced rock slope rating system, MDT would satisfy the immediate goals of identifying current needs, and they would position themselves to achieve the long-range goals of a TAM Plan and the P3 process. In the absence of this information, MDT would lack the ability to prove quantitatively that it is minimizing life cycle cost while protecting system performance and it would be unable to meet the federal criteria for inclusion of this asset class within the TAM Plan

3.4 Tasks

- 3.4.1 Review Literature and State of Practice
- 3.4.2 Assess Completed MDT Rockfall Mitigation Projects
- 3.4.3 Develop and Refine MDT's Rockfall Hazard Rating Criteria
- 3.4.4 Assess Rockfall Sites in Montana
- 3.4.5 Determine Current Critical Sites
- 3.4.6 Develop Cost/Benefits
- 3.4.7 Evaluate Compatibility
- Reports and Meetings
- 3.5 Deliverables and Meetings

3.4 TASKS

3.4.1 REVIEW LITERATURE AND STATE OF THE PRACTICE

Task 1: We propose conducting the literature review prior to the kick-off meeting in order to review current state of the practice and compare these methods with MDT's current practices and future goals.

Task 1a: Perform Literature Review - Team members are very familiar with the current state of the practice, with several serving on related Transportation Research Board Committees and performing a range of work in the development of rockfall management systems for other agencies. We propose to build on this experience and information, and we would contact other agencies that have reported developing or implementing a rockfall management system and check if those agencies have altered their management strategy since the survey was completed in 2008.

Task 1b: Kick-off meeting.

This would be held soon after receiving Notice-to-Proceed to meet with the MDT's Research Team to discuss the scope of work, data requirements, timelines, and any potential issues that should be addressed early on in the project.

At this meeting, we would discuss the current system and its ability to be adapted to better fit MDT's current and future needs. Agency personnel that should attend this meeting would be the MDT staff preparing the Department's TAM plan, representatives from the Geotechnical Staff, and Research Staff that would be overseeing this project. Our Key Staff would be in attendance at this meeting.

An agenda would be prepared in consultation with MDT prior to the meeting.

Within two weeks following the meeting, LT would submit meeting minutes to MDT for review and approval.

Task 1c: IT Infrastructure Meeting. Soon after the Kick-off meeting, LT and GCS would meet with the relevant MDT IT personnel to review the existing Oracle Database structure, discuss desired GIS products, and define how GIS-based tools can assist with development of a TAM-compatible rockfall management system.

Task Deliverables:

- Kick-off Meeting Agenda and Minutes
- IT Infrastructure Meeting Minutes
- Task Report for Section 3.4.1, Task 1
- Monthly Progress Reports

3.4.2 ASSESS COMPLETED MDT ROCKFALL MITIGATION PROJECTS

Task 2: The objectives of this task is to determine actual mitigation and maintenance costs, successes, and lessons learned from previous MDT efforts. Obtaining a comprehensive and full set of information for MDT's mitigated rockfall sites would best be accomplished with individual site visits with our rockfall specialists and key MDT staff. While an office study may be less costly, this approach would provide invaluable site-specific information critical for making an idealized system.

LT's rockfall mitigation specialists propose to meet with District Geotechnical and Maintenance personnel to visit rockfall sites that have been mitigated or constructed since the RHRS was completed. For each of the sites, we would review construction and ongoing maintenance demands to identify successes and

opportunities for improvement, and describe lessons learned from each of the mitigated sites in terms relevant to the RHRS and TAM principles.

For each site visit, we respectfully request the participation of the District Geotechnical staff responsible for rockfall evaluation and response as well as those Maintenance staff with the greatest experience with rockfall patrols and ditch maintenance to perform the field visits.

A partial list of the mitigated or newly constructed sites for the performance of a site evaluation are:

- **District 1 - Missoula**
  - US 2 – Libby Rockfall
  - US 2 – Libby Creek South Rock Cuts
  - MT 200 – Weeksville Rock Cuts
  - MT 1 – Flint Creek Rockfall
  - I-90 – MP 6.5, 22, and 24 Rockslides
- **District 2 – Butte**
  - I-15 – Rock Slope West of Basin
- **District 3 – Great Falls**
  - US 2 – Black Butte Rockfall
  - I-15 – Stickney Creek Rockfall
- **District 5 – Billings**
  - Beartooth Pass – Debris Flows and Rockfalls
  - Zimmerman Trail Rockfall

Following the site visits, our team would provide summaries of the observed conditions and describe the potential changes to the Rockfall Rating Process that could be implemented to capture the improved condition, better performance, and the reduced risk of the mitigated or new slope. For estimation purposes, visits to 12 mitigation sites are assumed.

At this stage, the concepts behind the risk-based TAM system would begin to be considered. The frequency of rockfall prior to and following the construction of mitigation measures would be documented and evaluated.

Task Deliverables:

- Task Report for Section 3.4.2, Task 2 including summaries of improvements observed in slope performance following mitigation activities.
- Monthly Progress Reports

3.4.3 DEVELOP AND REFINE MDT'S ROCKFALL HAZARD RATING CRITERIA

Task 3: The objective of this task is to define, validate, and potentially modify current rockfall hazard rating criteria for Montana/MDT needs and concerns. To accomplish this, we would continually communicate with MDT geotechnical, TAM, and research staff to adjust the system based on the items identified during Task 1 and 2.

Our team has found success in developing TAM-compatible rock slope condition assessments for RHRS-derived categories, making correlations and time-history based deterioration calculations (potentially part of a possible second phase) for rock slopes.

To develop these revisions, we propose the following tasks:

Task 3a: Develop Level of Service or Performance Measures for rock slopes, potentially based on Functional Classification.

Task 3b: Develop Condition States that are compatible with past RHRS scoring criteria, such as defining slope performance based maintenance requirements, rockfall history, and ditch effectiveness.

Task 3c: Develop an approach for calculating either qualitative or quantitative risk and resiliency measures for rock slopes.

Task 3d: Following the completion of the field work described in Section 3.4.4 (Task 4), LT would revisit, revise, and finalize the products developed within this task based on a complete, statewide dataset.

(Optional Task) To expedite data collection, we propose an optional task to create and field test a GIS-based data collection platform to facilitate fieldwork and allow better definition of rock slope sections (e.g. polygon areas), areas of high rockfall activity, maintenance requirements, and particularly hazardous rockfall features. This optional task would be used in the next task, but could be part of a potential second phase.

Task Deliverables:

- Task Report for Section 3.4.3, Task 3 describing the draft revised system to be implemented in the following phase
- (Optional) Draft Field Data Collection Platform
- Monthly Progress Reports

3.4.4 ASSESS ROCKFALL SITES IN MONTANA

Task 4: The objectives of this task is to perform field visits to the highest priority sites determined from the original ratings completed about 10 years ago (likely 200 to 500 rockfall locations) and then rerate the sites using updated rating criteria. Based on Addenda No. 1, approximately 400 sites for reevaluation are to be assumed. This would essentially be the 368 A sites identified during the original project with the addition of any high hazard B slopes that may have deteriorated since the original rating. Fortunately, these high B slopes would likely already have historic detailed rating information available for evaluation in our database.

To accomplish this task, the following subtasks would be carried out:

Task 4a: Create field forms. These forms would contain both the previous rating and maintenance survey data for those sites to be rerated.

Task 4b: Coordinate with MDT Maintenance Staff for site visits. Ideally, we would visit the site with MDT Maintenance personnel to review the previous information and update historic data as needed. Field ratings would be performed in the summer months when Maintenance personnel may have some additional availability and weather would be more conducive for viewing slope conditions. Coordination will occur prior to travel to the area to confirm that MDT personnel will be available.

Task 4c: Perform the site ratings. Our team has extensive experience with rating MDT's slopes. In previous efforts, an average of 10 to 20 sites per day were rated, depending on drive time between sites. In this task, drive time may be increased since fewer slopes are assessed, but an abbreviated site visit may be possible as some site measurements may not need to be repeated, such as sight distance. Updated information, such as AADT or speed limits can be input prior to the site visits for updated category ratings such as average vehicle risk and percent decision site distance. The 368 A-sites to be revisited are shown on the following page.

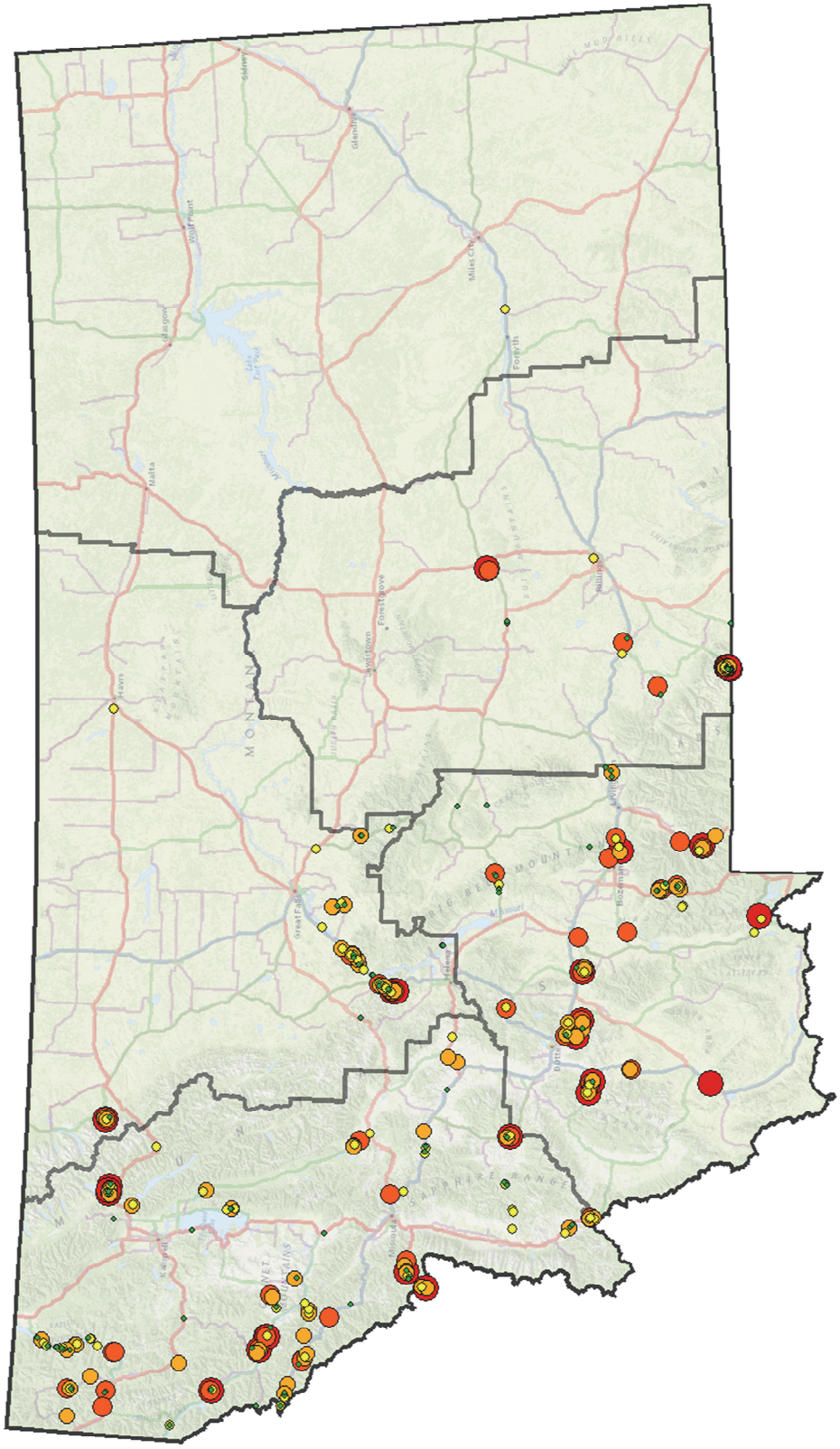


FIGURE 1: MAP DISPLAYING 368 ROCKFALL SITES WITH RHRS SCORES ABOVE 350 POINTS.

Task 4d: Transfer field data into a digital format. We would convert our data into a spreadsheet or other digital format for reporting and analysis needs. If the Optional GIS field data collection platform is adopted, this task may be revised or eliminated.

(Optional Task) Revise and finalize the GIS-based data collection platform based on any issues identified during the field rating process.

Task Deliverables:

- Task Report for Section 3.4.4, Task 4 describing the field ratings and summary statistics.
- (Optional) Revised Field Data Collection Platform
- Monthly Progress Reports

3.4.5 DETERMINE CURRENT CRITICAL SITES

Task 5: The goal of this task is to select a subset of MDT's most critical sites on a statewide basis and develop updated mitigation designs and cost estimates.

Task 5a: Develop current rockfall mitigation element costs for Montana. LT proposes to generate current unit prices for commonly utilized rockfall mitigation elements such as scaling, rock bolts, draped mesh, and various rockfall barriers and attenuators. Considering our recent extensive history with MDT rockfall projects, this subtask would be able to utilize both engineering estimates on the D3 I-15 project and actual bid costs, once it is let.

Task 5b: Develop rockfall mitigation measures and quantities. To perform this task, LT staff would utilize the data collected during the previous tasks and develop office-based conceptual cost estimates. For cost estimating purposes, we propose to perform conceptual cost estimates for the 30 most critical sites, or three high hazard corridors.

Task 5c: Develop cost estimates for ancillary efforts. We would incorporate costs for ancillary efforts such as project development (preliminary engineering and PS&E), traffic control, mobilization, contingency, and construction engineering; which are criteria not included in the original cost estimating exercises.

To efficiently complete this task, the above ancillary costs would be categorized into low, medium, high and expressed as percentages of the estimated rockfall mitigation costs. For example, a project may contain rockfall mitigation costs on the order of $750,000. To generate the total conceptual cost estimates, we would develop and assign factors for each ancillary cost. In the example below, preliminary engineering was assigned a medium effort or 8% of the $750,000 estimated for rockfall mitigation cost. Similar factors can be assigned to the other categorized ancillary costs to develop a total conceptual cost estimate as shown below.

A	$ 750,000	Rockfall Mitigation Costs
B	$ 60,000	Preliminary Engineering (Medium, 8%), (A x 0.08)
C	$ 60,000	PS&E (Medium, 8%), (A x 0.08)
D	$ 75,000	Traffic Control (High, 10%), (A x 0.10)
E	$ 49,500	Mobilization (Low, 6%), ((A+D) x 0.08)
F	$ 87,450	Contingency (Medium, 10%), ((A+D+E) x 0.10)
G	$ 96,195	Construction Engineering (Medium, 10%), ((A+D+E+F) x 0.10)
	$ 1,178,145	**Total Conceptual Cost Estimate**

Appropriate Indirect Cost (IDC) for both Construction and Construction Engineering could be added as a percentage as well. LT would work closely with MDT staff to develop these categories and percentage factors via

technical memos with collaborative finalization in a video teleconference setting.

Task 5d: Finalize Conceptual Mitigation Cost Estimates: Following the above tasks, we would prepare the Task Report summarizing the above efforts.

(Optional Task) Perform cost estimation in the field. While the office studies for conceptual design cost estimates would prove satisfactory, conceptual cost estimating derived from purposeful field visits by our highly experienced rockfall experts in conjunction with MDT Geotechnical and input from Maintenance staff would provide the most valuable and accurate estimates.

(Optional Task) Perform cost estimates on additional sites. To obtain a greater range of site or rockfall corridor cost estimates, LT could perform cost estimates on the top 50, 75, or 100 highest risk/worst condition sites.

Task Deliverables:

- Task Report for Section 3.4.5, Task 5 describing the cost estimating approach and results
- Monthly Progress Reports

3.4.6 DEVELOP COST/BENEFITS

Task 6: The objective of Task 6 is to develop cost/benefit scenarios that include safety, highway users, and construction cost estimates. The number of sites to estimate these costs would be the same number of sites determined appropriate in Task 5 (e.g. 30 sites).We would accomplish this through performing the following tasks:

Task 6a: Determine average annual maintenance costs per site or corridor segment. Through contact with local MDT maintenance personnel, the annual costs for maintaining the roadside ditch would be determined. Where ditch maintenance is not occurring, the increased risk-cost due to rocks more likely entering the roadway to MDT would be estimated.

Task 6b: Estimate highway user costs. Road user costs due to potential rockfall-related delays would be estimated using available FHWA (Work Zone Road User Costs, 2011) and MDT (Work Zone Safety and Mobility, rev. 2009) cost estimating guidelines and techniques. These conceptual costs would be developed using the most recent AADT and commercial count data for Traffic Flow Segments (http://www.mdt.mt.gov/publications/datastats/traffic_maps.shtml), and conceptual delay times based on delays expected from a temporary road closure followed by a longer term Work Zone Delay while a site is mitigated.

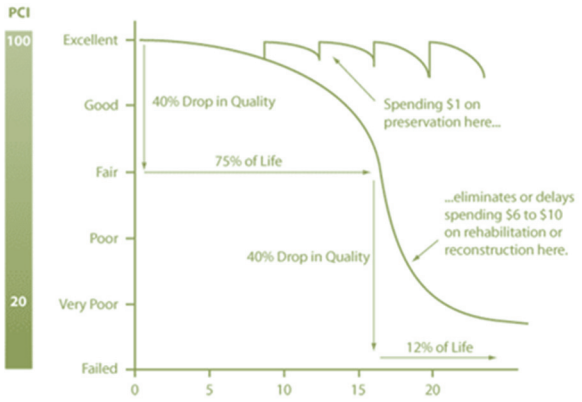
Task 6c: Estimate safety risk. An estimation of risk would be made based on the revised system and data originating from the field ratings. Safety risk parameters include the ability for a driver to react to a rock in the road, the average time that driver is within a rockfall site, AADT, and the presence of geologic features that appear inherently unstable or produce a history of high rockfall activity. This safety risk would be utilized to prioritize either corridor segments that contain a large number of rockfall sites, individual rockfall sites, or between sites within a high rockfall hazard corridor.

Task 6d: Aggregate costs and benefits for site or corridor selection. Based on the above tasks, mitigation cost estimates would be compared to the maintenance costs and estimated user costs to determine cost benefit ratios. Combined with

potential safety risk, a listing of prioritized sites or corridors would be generated.

(Optional Task): Monetize safety risk. To better account for cost factors determining potential risk costs to MDT, we propose researching relations between deterministic or probabilistic occurrence of property damage, injury accident, and fatality risk related to rockfall occurrence.

(Optional Task) Develop deterioration curves and intervention actions. Based on previous and new condition data, conceptual degradation curves would be generated, much like the pavement sample below. This effort could also be part of a Phase 2.



Task Deliverables:

- Task Report for Section 3.4.6, Task 6 describing the development of cost/benefit approach and results
- Monthly Progress Reports

3.4.7 EVALUATE COMPATIBILITY

Task 7: The goal for this task to evaluate the compatibility of both the revised rockfall hazard rating system compatibility with a future TAM Plan and how it can be integrated into MDT's IT and enterprise GIS environment. We plan on incorporating the following tasks to complete this Task:

Task 7a: Review MDT's current RHRS IT infrastructure. Soon after the Kickoff meeting, Landslide Technology's subconsultants, GCS, would participate in a demonstration of the current Oracle database housing the RHRS data. A 'behind-the-scenes' look at the database structure hosted by MDT's IT personnel would be required for GCS to determine the compatibility of the current RHRS system into a GIS based environment. An overview of the desired outcome envisioned by the draft TAM plan would also be required. GCS would prepare a memo describing how they currently work together and what may be needed to ensure future compatibility.

Task 7b: Identify additional requirements for a future TAM plan. A memo would be prepared that outlines the steps that may still be required to make it fully compatible with transportation asset management principles, MDT's draft TAM plan, and MAP-21 principles.

Task 7c: Update GCS review. Depending on the development of MDT's IT and GIS infrastructure during the two-year duration of this project and the progress of the TAM plan, GCS would prepare an updated memo describing the then-current needs for compatible database.

Task Deliverables:

- Task Report for Section 3.4.7, Task 7 evaluating the compatibility of the revised RHRS system in both terms of IT/GIS and TAM compatibility.
- Monthly Progress Reports

TASK 8: REPORTS & MEETINGS

Task 8: This added task involves preparing all reports and attending meetings as defined in Section 3.5 of the RFP. The goal of this added

task is to synthesize the work performed in the previous tasks in the required formats. We would accomplish this effort in the following subtasks. All Task Reports are included in their respective task as outlined above.

Task 8a: Prepare draft Final Report and Final Oral Presentation. A draft version of the final report would be prepared for review in the format described in RFP section 3.5. The report would describe the work performed in all the previous tasks and provide a clear and concise description of all project activities.

As part of this task, the research team would assemble in Helena and formally present research Project results to MDT employees and other interested parties. Two weeks prior, the meeting agenda and materials would be submitted to the MDT Research Project Manager.

Task 8b: Prepare draft Research Summary Report. A draft version of a Research Summary Report would be prepared in the required format.

Task 8c: Prepare draft Implementation Report. A draft version of an Implementation Report would be prepared in the required format. As part of this task, the research team would convene an Implementation Meeting to discuss implementation recommendations, additional items for implementation, and any unmet research needs.

Task 8d: Prepare draft Performance Measure Report. A draft version of a performance measure report, including qualitative and quantitative output and outcome performance measures would be prepared. A TR News Research Pays-off is an *Optional Task.*

Task 8e: Finalize Reports. Based on MDT feedback, all reports would be finalized in the required format.

3.5 DELIVERABLES AND MEETINGS

All deliverables and meetings are discussed in detail in the preceding sections.

- Monthly Progress Reports and Task Reports are accounted for in each individual task.
- The deliverables for: Final Report and Cover Picture; Research Summary Report; Implementation Report; and Performance Measure Report are contained in Task 8.
- Kick-Off meeting is accounted for in Task 1
- The Final Oral Presentation and the Implementation Meeting is accounted for in Task 8.

4. Offeror Qualifications

- 4.2.1 Client Reference Questionaire
- 4.2.2 Company Profiles and Experience
- 4.2.3 Staffing
- 4.3 Oral Presentation and Interview

4 OFFEROR QUALIFICATIONS

4.2 OFFEROR QUALIFICATIONS

The following sections include the team's client reference questionnaires, company profiles, team experience and key personnel. The Profile and Experience Section includes a brief description of each firm, a description of relevant and comparable projects, and references to sample work products contained in the tabbed sections at the end of this proposal. The Staffing section includes our team organizational chart, a list of key staff, and their resumes.

Commitment letters from each of our subcontractors is contained in the appropriate tabbed sections.

The Landslide Technology team does not take exception to any requirements in this section.

4.2.1 CLIENT REFERENCE QUESTIONNAIRE

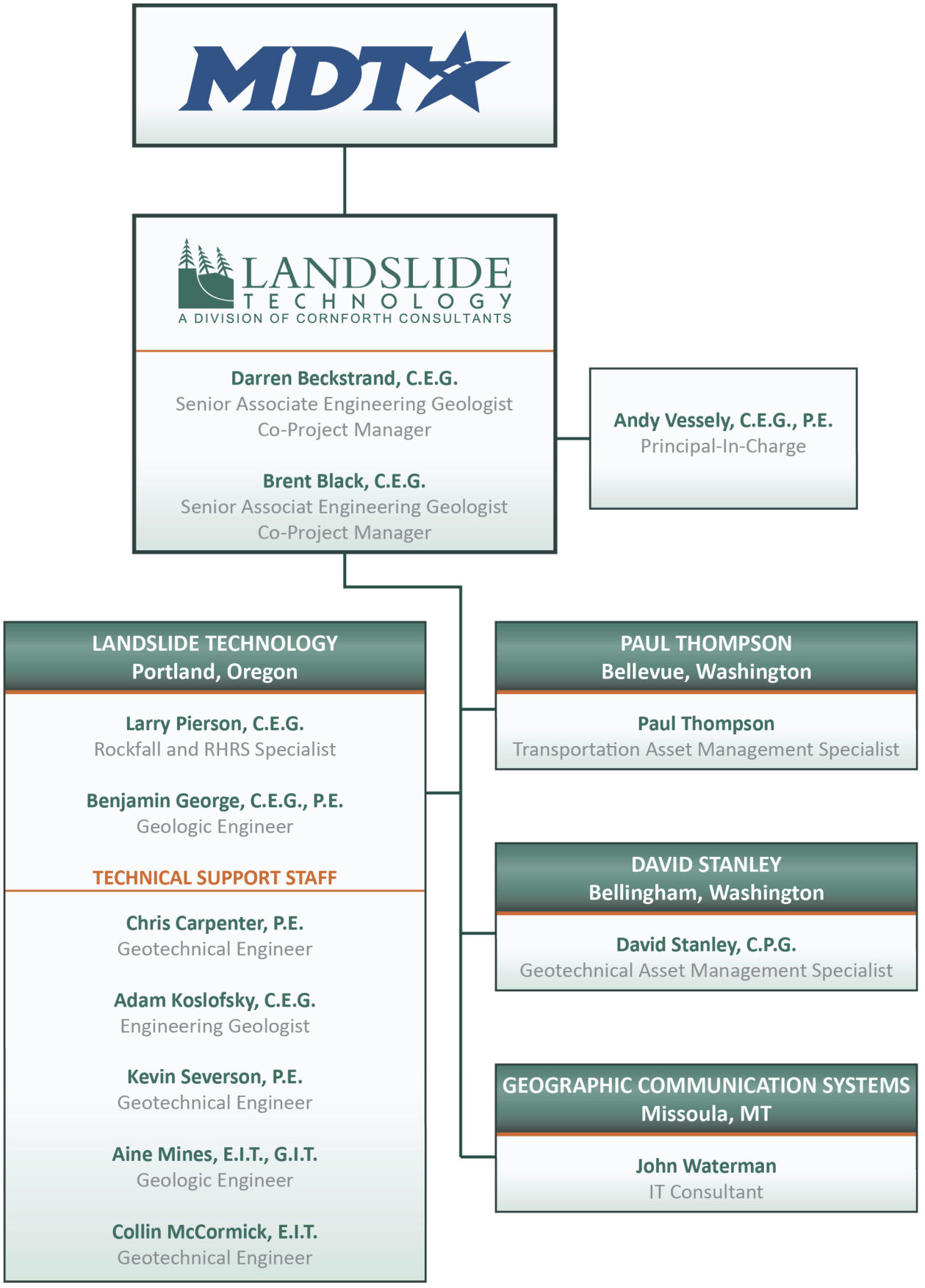
Our team has contacted three State transportation agencies, and requested that they fill out the reference questionnaire. All completed questionnaires are contained in the tabbed section near the end of this proposal. These agencies and personnel are:

- *Mr. John Sharkey, Montana Department of Transportation.* Landslide Technology has provided evaluation and design efforts for about two dozen rockfall-related related projects during the past five years, a number of which have been in Mr. Sharkey's District. See the relevant projects contained in Table 1 later in this section.
- *Mr. Stephen Hay, Oregon Department of Transportation.* Related services provided include rockfall mitigation design or rock slopes design services for local rock slopes.
- *Ms. Lynn White, Idaho Transportation Department.* Related services include evaluation of existing rock cuts, determining performance of current rock cut slopes, and utilizing performance and subsurface data for the design of new rock cuts on a high mountain pass (Galena Summit) north of Ketchum, Idaho.

4.2.2 COMPANY PROFILES AND EXPERIENCE

The profiles of the companies comprising the Landslide Technology Team and relevant project descriptions are contained in the following sections. Work product examples for representative projects are contained on the CD in the tabbed section of this proposal.

Our LT team includes the principal researcher and developer of the original RHRS; key project staff that developed and implemented MDT's current RHRS; and nationally recognized experts in the development of rock slope management procedures compatible with current TAM systems. In addition, LT has extensive recent experience with MDT's rock slope problems and mitigation needs. This gives our team very specific and relevant experience that helps us understand the specific issues facing MDT and how the rockfall evaluation process can be improved. This experience would provide the added benefit of consistent evaluations with only minimal staff preparation.


MDT
LANDSLIDE TECHNOLOGY
A DIVISION OF CORNFORTH CONSULTANTS
Darren Beckstrand, C.E.G.
Senior Associate Engineering Geologist
Co-Project Manager
Brent Black, C.E.G.
Senior Associat Engineering Geologist
Co-Project Manager
Andy Vessely, C.E.G., P.E.
Principal-In-Charge
LANDSLIDE TECHNOLOGY
Portland, Oregon
Larry Pierson, C.E.G.
Rockfall and RHRS Specialist
Benjamin George, C.E.G., P.E.
Geologic Engineer
TECHNICAL SUPPORT STAFF
Chris Carpenter, P.E.
Geotechnical Engineer
Adam Koslofsky, C.E.G.
Engineering Geologist
Kevin Severson, P.E.
Geotechnical Engineer
Aine Mines, E.I.T., G.I.T.
Geologic Engineer
Collin McCormick, E.I.T.
Geotechnical Engineer
PAUL THOMPSON
Bellevue, Washington
Paul Thompson
Transportation Asset Management Specialist
DAVID STANLEY
Bellingham, Washington
David Stanley, C.P.G.
Geotechnical Asset Management Specialist
GEOGRAPHIC COMMUNICATION SYSTEMS
Missoula, MT
John Waterman
IT Consultant

COMPANY PROFILES

COMPANY PROFILE - LANDSLIDE TECHNOLOGY

Since 1983, Landslide Technology (LT), a division of Cornforth Consultants, Inc., has undertaken a broad range of work assignments relating to geotechnical engineering and geologic reconnaissance, analysis and design. Roughly 70% of LT's work is related to landslides, roadway embankments, soil and rock cut slopes, rockfall mitigation, bridge and retaining wall structures and other complex geotechnical issues for transportation agencies. In addition, the firm also specializes in geotechnical instrumentation for landslide and rockslide characterization and monitoring systems. LT has investigated over 500 transportation and slope stability projects in the United States and Canada, including work in the states of Montana, Wyoming, Idaho, Utah, Colorado, Oregon, Washington, Alaska, Arizona, New York, and Ohio, and the province of British Columbia. Representative projects contained later in this proposal demonstrate LT's experience related to transportation infrastructure and rockfall management.

A detailed description of key similar projects, including the types and dates of services is provided below. The summary table below illustrates Landslide Technology's extensive recent experience with MDT's rock slopes.

COMPANY PROFILE - PAUL THOMPSON

Mr. Thompson's firm is a sole proprietorship consultancy specializing in management systems and engineering economics.

A brief bio is contained in Section 3.4.4 and a detailed resume is provided near the end of this proposal in the tabbed Resume section.

COMPANY PROFILE - DA STANLEY CONSULTING

D.A. Stanley Consulting (DASC) is a sole proprietorship that specializes in consulting for federal, state and local transportation agencies. A new firm, DASC's principal focus is advising clients regarding transportation asset

TABLE 1: LANDSLIDE TECHNOLOGY'S ROCKFALL PROJECTS WITH MDT

I-15 D3 Rockfall Mitigation Final Design, Helena to Great Falls – *2012-Present*
I-90 MP 22.5 Rockfall, De Borgia – *2015*
I-90 MP 6.5 and 24 Rockfall Mitigation QA/QC, St. Regis – *2014*
Libby Creek South Rock Slope, Libby – *2014*
US 2 Badrock Canyon Rock Slope Monitoring and Instrumentation, Columbia Falls – *2007-2014*
I-90 MP 24.4 Slide, St. Regis – *2013*
Clearwater Junction Geotechnical Explorations and Evaluation, Swan Valley – *2011*
US 2 Black Butte Rockfall, Havre – *2011*
I-15 Stickney to Hardy Creek Rockfall, Cascade – *2010*
US 2 Libby Rockfall Construction Assistance, Libby – *2007*
US 93 Lakeside Rockfall Construction Assistance, Lakeside – *2007*
MT 200 Weeksville Rock Bolt Installations, Thompson Falls – *2006*
Beartooth Highway Slides, Red Lodge – *2005*
MT 49 Looking Glass Hill Road Landslide and Rockfall Mitigation, East Glacier – *2005-2006*
Libby Rockfall Mitigation Design, Libby – *2004*

management and specifically the new field of geotechnical asset management. Geotechnical asset management (GAM) focuses on developing and implementing programs for wise management of agency infrastructure and assets such as slopes, embankments, retaining walls, materials sources.

COMPANY PROFILE – GEOGRAPHIC COMMUNICATION SYSTEMS (GCS)

GCS delivers highly customized solutions that communicate meaningful geographic information and enhance workflow optimization. Their clients come to us from a broad spectrum of industry sectors with a common need: streamlined access to business insights distilled from complex data. Their technical expertise and collaborative client relationships allow us to design the powerful, elegant solution needed to maximize productivity. Their systems are crafted at the convergence of cloud, analytics, and mobility to ensure access to answers everywhere, all the time.

For over a decade, their award-winning team of experts has integrated and adapted best-of-class GIS platforms with cutting-edge technology to extract value from data, and opportunities from information. Dedicated teams work with clients for the life of a project to ensure the delivery of precise solutions for unique business challenges. Their ability to remain agile and responsive sets GCS apart from industry giants.

WORK EXAMPLES – ELECTRONIC COPIES

Landslide Technology has prepared a work sample of three recent, relevant projects completed in the past five years. The sample report documents are stored on a CD contained in the tabbed Work Examples section of this proposal. These projects include:

- *D3 I-15 Rockfall Mitigation. Client: MDT. Key Staff Authors: Brent Black and Ben George.* Related services provided in this project was the evaluation, prioritization, and full consultant PS&E of 15 high hazard rockfall sites on I-15 between Sieben and Wolf Point.
- *I-90 MP 24.5 Rockfall Evaluation, Project Review, and QAQC for Design-Build Rockfall Mitigation. Client: MDT. Key Staff Authors: Darren Beckstrand, Brent Black, and Ben George.* Relevant services include evaluation of deteriorating rock slopes in a high hazard, high traffic corridor where hazard and risk to the public are increasing with time.
- *Enterprise Transportation Asset Management, Synthesis and Work Plan Final Report. Client: AKDOT. Key Staff Author: Paul Thompson.* Relevant services include a of the State's TAM system and provides recommendations for incorporating asset management principles into the decision making process.

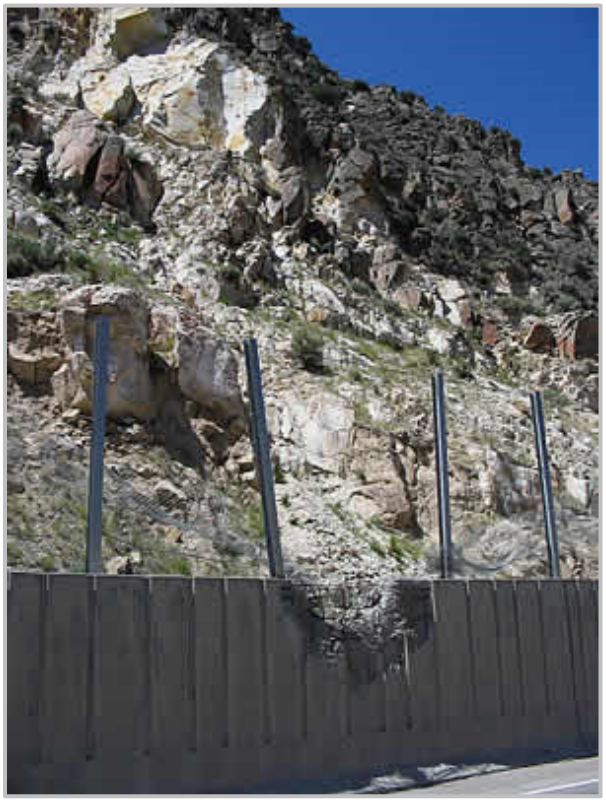
RELEVANT PROJECTS

PROJECT - MONTANA RHRS

Years: 2003-2005. MDT POC: Craig Abernathy (406) 444-6269

The Montana Department of Transportation (MDT) selected Landslide Technology to implement the Rockfall Hazard Rating System (RHRS) to better manage rock slope assets along MDT highways. The results provide a relative ranking of rock slopes and allowed sites to be prioritized for capital expenditures for mitigation. The system uses maintenance

history, slope geometry, highway characteristics, traffic data, and geology and provides a unique numerical rating for each slope.



The RHRS implementation was performed in a phased approach over two years. The first phase involved reviewing MDT digital photograph inventory for every mile of highway in the MDT system. The photo review resulted in an inventory of approximately 2,500 rock slope locations and general site descriptions. Site visits and field preliminary ratings were made at each rock slope identified in the image inventory. Landslide Technology developed a database to store the rock slope data and rating information.

Based on the preliminary ratings, detailed ratings were completed at approximately 850 sites. Conceptual designs and construction cost estimates were prepared for the top 100 rated sites.

PROJECT – I-15 (D3) ROCKFALL MITIGATION – HELENA TO GREAT FALLS, MONTANA

Years: 2013-Current. MDT POC: John Sharkey (406) 444-6286 and Blair Nordhagen (406) 444-9128.

Interstate 15 has many existing rock cuts and natural rock slopes that periodically fail and pose safety risks to highway users and increased maintenance efforts for MDT personnel. LT was retained by MDT to assist with design of rockfall mitigation and slope stabilization measures for 15 sites in a 27-mile corridor between Helena and Great Falls. LT performed field reconnaissance and geologic mapping using remote 3D photography equipment and software (Sirovision) to collect relevant rockfall and structural data and evaluate the rockfall hazards associated with each site. Following this field effort, conceptual rockfall mitigation options (30% design) were developed for each site and presented to MDT for advancement to final design. MDT requested that final rockfall mitigation design be performed on nine of the 15 sites. Design teams have recently completed rock slope stability evaluations and rockfall simulations as part of the design process. Mitigation measures include trim blasting, scaling, draped-mesh, high-energy retention or attenuation systems, rock bolting, triple-rail installation, concrete barriers, and expanding fallout areas. A PS&E package for six of the

nine rockfall mitigation sites was delivered and is scheduled for letting. LT is currently developing the final design package for the remaining three rockfall mitigation sites.

PROJECT – I-90 MP 24 ROCKFALL MITIGATION, ST. REGIS, MONTANA

Years: 2013-2014. MDT POC: Tyrel Murfitt (406) 444-9259 and Bret Boundy (406) 444-6278.

LT was retained by MDT to provide rockfall mitigation plan review and construction engineering services in conjunction with a Design Build (DB) contract released by the Department to mitigate rockfall issues for two cut slopes between mile posts 24.0 and 24.8 on westbound Interstate 90. LT provided review of the DB qualification responses, evaluation support during review of DB technical proposals from contractors, and on-site technical services for design implementation and construction of the rockfall mitigation measures. To adequately evaluate the proposals, LT's engineering geologists performed two site visits during which a reconnaissance and 3D structural photogrammetry was performed at both slopes. LT was able to determine the critical features to address for stability mitigation and construction. Our services during the preliminary phase have included assisting MDT with the review and evaluation of construction documents, and review of DB team submittals such as geotechnical design reports, shop drawings, and plan sets. During the upcoming construction phase, our Society of Professional Rope Access Technicians (SPRAT) certified engineering geologists will assist MDT with on-site observation of the stabilization work on the steep rock slopes. Following completion of the work, our senior geologist will provide a final site evaluation.

PROJECT – UNSTABLE SLOPE PROGRAM DEVELOPMENT FOR FLMAS

Years: 2013 to current. WFLHD POC: Doug Anderson (360) 619-7958.

As part of the recently enacted MAP-21 Act, Western Federal Lands Highway Division (WFLHD) is coordinating with various Federal Land Management Agencies (FLMAs) including the USDA Forest Service, National Park Service, Bureau of Land Management, and the Bureau of Indian Affairs to develop an evaluation and inventorying system for the FLMA's road and trail networks.

Building upon Landslide Technology's experience in developing the Unstable Slope Management Program (USMP) for the Alaska Department of Transportation & Public Facilities (AKDOT&PF), WFLHD contracted with our firm through AKDOT&PF to adjust the system for FLMAs and carry out a pilot implementation project. The first phase included coordination with FLMAs, developing and finalizing a field form and explanatory document for site evaluation, leading an educational site visit to the Gifford Pinchot NF involving all Federal stakeholders, and carrying out and documenting a pilot implementation of slope ratings on agency slopes.

The USMP system has been designed to account for traffic volumes, and specifically calibrated toward lightly used, rural federal roadways for FLMAs. The customized system includes categories for notable environmental and cultural elements, and can accommodate the various missions and objectives for each agency. In areas where no traffic counts are available, the rating system factors in the economic and recreational importance of the roadway to assess its priority for mitigation. Federal thresholds for cost and design efforts were also factored into the system. After the rating categories and descriptions were finalized, approximately 120 slopes were rated with the results and maps shared with the FLMA stakeholders.

A second phase of this project is underway with the development of performance measures, cost estimating approaches, and database development. This second phase will be contracted through the Western Transportation Institute based at Montana State University in Bozeman, Montana.

PROJECT - ALASKA GEOTECHNICAL ASSET MANAGEMENT PROGRAM DEVELOPMENT

The Alaska Department of Transportation & Public Facilities (AKDOT&PF) is currently conducting research into Geotechnical Asset Management of the Department's unstable rock and soil slopes. With AKDOT&PF, Landslide Technology (LT) is assisting with testing and finalizing the state's Unstable Slope Management Program (USMP) and with implementing the program statewide.

During the field phases, LT has provided field crews to categorize and rank the state's unstable slopes. Crews have visited many of the slopes and applied the State's newly adopted rating criteria, resulting in preliminary, hazard, and risk rating and condition assessments.

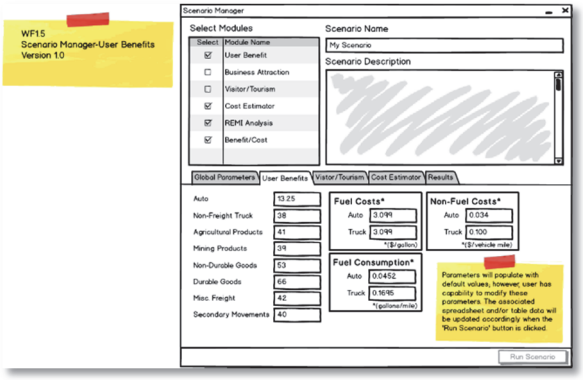
Prior to the field activities and based on extensive experience in performing statewide slope inventory systems, LT assembled a database and interface to contain all the field rating information. The database interacts with both Google Earth and ESRI's GIS programs, which allows the Department to easily view rating information and field photographs.

As the inventory and condition survey are underway, LT will help develop performance measures; and Level of Service and agency compliance criteria to integrate asset management principles into their slope management system.

PROJECT – MDT HIGHWAY ECONOMIC ANALYSIS TOOL (HEAT2) (GCS)

GCS is developing the latest release of MDT's Highway Economic Analysis tool. This geospatial application is integrated into Esri's ArcGIS and leverages the Agency's enterprise geodatabase.

HEAT2 is integrated with economic modelling software allowing users to generate realistic year-by-year estimates of the total regional effects of any specific policy initiative. A wide range of policy variables allows the user to represent the policy to be evaluated, while the explicit structure in the model helps the user to interpret the predicted economic and demographic effects.



HEAT2 comes in the form of a custom Add-In for ArcMap. The Add-In serves to tie together all the different tool components, including business logic, user interfaces, standard out of the box editing tools, and data access layers. Once built, HEAT2 encapsulates the full implementation of the tool in a single installation file that can be quickly deployed, either manually by a user or through automated mechanisms controlled by IT staff. HEAT2 also includes a configuration file that holds predetermined values that control functionality. These configuration values may include things like the server name and connection information for a database; the local folder path where a user's scenarios will be stored; or a network path where module support files are located.

4.2.4 STAFFING

The staffing shown below is separated into Key Project Staff and Supporting Technical Staff. Key staff, named on the included cost estimate (Section 5), will not change for the duration of the project. Their total estimated number of hours and relative percentages are provided in Section 5 as well. Supporting Technical Staff are not expected to be individually highly utilized on the project except for certain field evaluation aspects, but they illustrate the strength of LT's engineering geologist and geotechnical engineering staff with rock mitigation work on Montana's slopes and with the implementation of large-scale slope evaluations. Resumes are for all listed staff are included in the tabbed Resume section.

KEY PROJECT STAFF

DARREN BECKSTRAND, C.E.G. (LT – ENGINEERING GEOLOGIST)

Mr. Beckstrand is a Senior Associate Geologist with LT. He has over 15 years of experience working on rockfall projects in Montana and throughout the western United States. He holds an M.S. degree in Geology from Portland State University, and is a Registered Geologist in Oregon, Washington and Alaska, and a Certified Engineering Geologist in Oregon and Washington.

Mr. Beckstrand assisted with the field efforts of the multi-year statewide implementation of MDT's Rockfall Hazard Rating System (RHRS). He was responsible for designing a custom Microsoft Access database for the preliminary and detailed rating phases of the

RHRS. The database incorporated crucial features, such as digital photograph management and detailed rating score calculations, to economize the field effort. Over 2,500 potential hazardous slopes were examined, with over 750 of these examined in the field by Mr. Beckstrand.

Mr. Beckstrand has also worked on condition and indexing systems for geotechnical asset management (GAM) programs in Alaska and Washington. He has worked on a variety of geologic reconnaissance and interpretation projects, and has developed a strong background and project experience in rock and soil slope instrumentation, long-term monitoring, data acquisition and storage, and in remote transmittal and plotting of geotechnical instrumentation data.

Mr. Beckstrand was a significant contributor to the Transportation Research Board Circular, "Use of Inclinometers for Geotechnical Instrumentation on Transportation Projects" (Oct. 2008), and a co-author of "Condition Indices, Performance Measures, and Managing Performance Data for Geotechnical Asset Management – Don't Get Buried!" - Geostrata March/April 2014.

Roles and Responsibilities: Co-Project Manager, see resume for additional qualifications.

Hours and percentage allotted: See the Cost Estimate, Section 5.

BRENT BLACK, C.E.G. (LT – ENGINEERING GEOLOGIST)

Mr. Black is a Senior Associate Geologist with LT. He has over 23 years of experience working as an engineering geologist throughout the western United States. Mr. Black has an M.S. degree in Geology from Kent State University, and is a Certified Engineering Geologist in Oregon and Washington, and a Registered Geologist in Idaho and Utah. He has gained a wide variety of experience in rock slope evaluations, analysis, and mitigation while working at LT, and has developed exceptionally strong project experience in working with specialty contractors that perform rock slope stabilization.

His areas of expertise include rockfall evaluations, rockfall and landslide mitigation, site investigation and instrumentation, geologic hazards, and construction quality assurance.

Mr. Black developed the conceptual rockfall mitigation designs and cost estimates for Montana's 100 highest rated sites during the multi-year statewide implementation of MDT's Rockfall Hazard Rating System (RHRS).

He is currently a panel member for the National Cooperative Highway Research Program (NCHRP) Project 24-35 - Guidelines for Certification and Management of Flexible Rockfall Protection Systems, and a member of the Subcommittee on Rockfall Management and Geotechnical Asset Management for the National Academy of Science - Transportation Research Board.

Roles and Responsibilities: Co-Project Manager, see resume for additional qualifications.

Hours and percentage allotted: See the Cost Estimate, Section 5.

LARRY PIERSON, C.E.G. (LT – ENGINEERING GEOLOGIST)

Mr. Pierson is a Staff Consultant with LT, and would serve as a senior reviewer and RHRS consultant. He holds a B.S. degree from the University of California at Los Angeles (UCLA) and is a Certified Engineering Geologist in Oregon and Washington. Mr. Pierson has over 37 years of transportation-

related experience as an engineering geologist, most of which has been dedicated to rockfall mitigation and rock slope investigation and design. Mr. Pierson dedicated 22 years working for the Oregon Department of Transportation as a Geotechnical Manager and Chief Engineering Geologist. He is a nationally recognized expert in the field of rockfall hazard evaluation. He currently serves as Chair of the TRB Committee on Engineering Geology.

Mr. Pierson was the principal developer of the Rockfall Hazard Rating System (RHRS) that has become the standard used by Federal agencies and many State DOTs across the United States. He implemented and managed the 2003 multi-year, statewide implementation of the Rockfall Hazard Rating System (RHRS) for the 10,000-mile-long Montana highway system. Work tasks included development of a customized RHRS database, production of a digital photograph management system, the detailed examination of over 2,500 potential hazardous slopes, and development of preliminary designs and cost estimates for the top 100 rated sites in the state.

Mr. Pierson is also the current Research Project Manager for developing and implementing the Alaska statewide Unstable Slopes Management Program (USMP) system. When completed, the USMP will include both hazard and risk assessments, condition surveys, service life predictions and condition indices for all unstable slopes throughout the Alaska highway system. As part of the agency's overall Transportation Asset Management initiative, the USMP will provide performance information used to guide Alaska's highway corridor investment strategies.

Roles and Responsibilities: Senior review and RHRS consultant, see resume for additional qualifications.

Hours and percentage allotted: See the Cost Estimate, Section 5.

BENJAMIN GEORGE, P.E., C.E.G. (LT – GEOLOGICAL ENGINEER)

Mr. George is an Associate Engineer with LT. He has over 11 years of geotechnical engineering experience in Montana and throughout the western United States. He holds an M.S. degree in Geological Engineering from the Colorado School of Mines, and is a licensed Professional Engineer in Montana (No. 33924), Oregon, Washington, and Alaska; a Certified Engineering Geologist in Oregon; and a Registered Geologist in Oregon and Wyoming. Mr. George is also a Society of Professional Rope Access Technicians (SPRAT) Level 1 Technician. He has extensive technical experience with rock slope investigation, mitigation design, and construction observation services. He served as LT's project engineer and on-site technical representative for MDT's US 2 Libby, US 93 Lakeside, and I-90 MP 6.5 and 24 Rockfall Mitigation Projects. He currently is the project engineer for the I-15 (D3) Rockfall Mitigation Project.

Roles and Responsibilities: Rockfall mitigation design specialist, see resume for additional qualifications.

Hours and percentage allotted: See the Cost Estimate, Section 5.

PAUL THOMPSON (ASSET MANAGEMENT SPECIALIST

Mr. Thompson is an international expert in management systems and engineering economics, specializing in transportation asset management (TAM). He has co-authored many of the fundamental manuals and guides used in TAM, including both volumes of the AASHTO Asset Management Guide, the Transport Association of Canada Asset Management

Guide, the AASHTO Guide for Bridge Management Systems, and the NCHRP Guide for Estimating Life Expectancy of Highway Assets. He has co-authored MAP-21 Transportation Asset Management Plans for Minnesota, Ohio, Nevada, Texas, and Alabama; and developed input to the TAM Plans and implementation plans of Louisiana, Alaska, Colorado, and Washington. He designed and managed the AASHTO Pontis bridge management system (BMS), and supported implementation in more than 30 agencies. He also served as system architect of the Ontario and Québec bridge management systems, and has supported implementation of these systems in several additional provinces. He has created more than a dozen bridge management systems world-wide, as well as management systems for pavements, transit facilities, and highway maintenance. He has been the lead researcher on many multi-year research projects and programs to develop engineering economic tools and risk management processes, and has assisted state and local governments to improve their asset management procedures and tools. He Chairs the Transportation Research Board Subcommittee on Bridge Life Cycle Cost Analysis, is a member of the TRB Committees on Bridge Management and Asset Management, and has served on the Editorial Boards of the ASCE Journal of Bridge Engineering and the Structure and Infrastructure Engineering Journal. In 2014 he was awarded the Senior Prize of the International Association for Bridge Maintenance, Safety, and Management in Shanghai, China for his 34 years of contributions to bridge management.

Roles and Responsibilities: Transportation asset management specialist, see resume for additional qualifications.

DAVID STANLEY, C.P.G. (ENGINEERING GEOLOGIST)

Dave Stanley, Principal of DASC, is an engineering geologist with 30 years of geotechnical experience. He holds a B.S. degree in Geology from Oregon State University and a J.D. (law degree) from University of Oregon. Mr. Stanley is registered as a Geologist in Alaska and is a licensed Geologist and Engineering Geologist in Washington. He has worked in a wide variety of capacities in engineering geology. After several years of technical experience, he attended law school and practiced law at a firm in Eugene, Oregon. Upon returning to AKDOT, he advanced to supervision and program management becoming the Chief Engineering Geologist and Geotechnical Services Manager in 2000. Since his retirement in 2014, Mr. Stanley has continued his national efforts to develop and advance geotechnical asset management for transportation agencies and began D.A. Stanley Consulting in mid-2014. He serves as chair of the TRB Joint-Section Subcommittee on Geotechnical Asset Management.

Roles and Responsibilities: Agency-perspective geotechnical asset management specialist, see resume for additional qualifications.

JOHN WATERMAN (IT & GIS SPECIALIST)

Mr. Waterman joined GCS in 2004. As the IT Technical Lead, his main focus is driving customer projects to successful completion. Mr. Waterman oversees the GCS's GIS development projects, professional development and training for team members, and expertise in new technologies, such as mobile and cloud GIS offerings.

Roles and Responsibilities: IT Consultant, see resume for additional qualifications.

TECHNICAL SUPPORT STAFF

Below are brief bios of technical support staff that have extensive experience on Montana's rock slopes and the implementation of rock slope asset management systems.

CHRIS CARPENTER, P.E. (LT – GEOTECHNICAL ENGINEER)

Mr. Carpenter is an Associate Engineer with LT. He has over 14 years of geotechnical engineering experience working on projects throughout the western United States. He holds an M.S. degree in Geotechnical Engineering from the University of California at Berkeley, and is a licensed Professional Engineer in Oregon, Washington, and California. He has extensive experience in landslide evaluations, monitoring, planning and design, and construction of mitigation measures. He is one of the firm's in-house earthquake engineering experts and would be assigned to provide recommendations relating to site-specific seismic analyses and mitigation measures that would address earthquake loading for structures, earth slopes and embankment fills.

Mr. Carpenter assisted with field investigations for the multi-year, statewide implementation of the Rockfall Hazard Rating System (RHRS). He conducted preliminary and detailed RHRS surveys of over 1,500 road cuts throughout the Montana highway system.

ADAM KOSLOFSKY, C.E.G. (LT – ENGINEERING GEOLOGIST)

Mr. Koslofsky is a Project Geologist with LT. He has ten years of engineering geology experience in Montana and throughout the western United States. Mr. Koslofsky holds a B.S. degree in Geology from Oregon State University, and is a Certified Engineering Geologist in Oregon. He is also a Society of Professional Rope Access Technicians (SPRAT) Level 2 Technician certified for the planning and implementation of rope access for challenging rock slope projects.

KEVIN SEVERSON, P.E. (LT – GEOTECHNICAL ENGINEER)

Mr. Severson is a Project Engineer with LT. He has over 6 years of geotechnical engineering experience working on projects in the western United States. Mr. Severson holds an M.Eng. degree in Geotechnical Engineering from Oregon State University, and is a licensed Professional Engineer in Oregon and Washington. He is also a Society of Professional Rope Access Technicians (SPRAT) Level 1 Technician and has provided on-slope reconnaissance, instrumentation, monitoring, and construction observation on numerous rockfall and landslide projects. He would provide in-house slope stability modeling, rockfall modeling, generation and evaluation of project plans and specifications in addition to his field expertise.

AINE MINES, E.I.T, G.I.T. (LT – GEOLOGICAL ENGINEER)

Ms. Mines has worked as a Staff Engineer with LT since 2011. She holds an M.S. degree in Geotechnical Engineering from the University of California at Berkeley, and is an Engineer-In-Training and Geologist-In-Training. She is also a Society of Professional Rope Access Technicians (SPRAT) Level 1 Technician for rope access at challenging rock slope projects. She performed extensive field investigations for the AKDOT Geotechnical Asset Management

(GAM) Program, conducting preliminary and detailed ratings of over 300 unstable slopes on Alaskan highways. She has developed asset valuation processes for inventoried geotechnical assets using data collected during field surveys.

COLLIN MCCORMICK, E.I.T (LT–GEOTECHNICAL ENGINEER)

Mr. McCormick has worked as a Staff Engineer for LT since 2013. He holds an M.S. degree in Geotechnical Engineering from the University of Washington, and is an Engineer-In-Training. He is also a Society of Professional Rope Access Technicians (SPRAT) Level 1 Technician Certified for planning and implementation of rope access for challenging rock slope projects.

WORK LOAD

The following table shows our Team's availability and proposed commitment to MDT's project for the Key Personnel during calendar years 2015 through 2017. The total resources of our combined companies provide over 30 staff that could be utilized as necessary with the approval of MDT to meet all proposed or accelerated scheduling.

Commitments. Our team is currently involved in several projects that include landslide stabilization, rockfall mitigation, and rock cut design. Several of these assignments are significantly large but nearing completion. The time commitments of the project staff for these projects have been accounted for in the table below. There are no specific project assignments that would preclude any of our key project staff from meeting MDT's needs for the duration of the contract.

RESOURCES

Landslide Technology's staff includes 24 geotechnical engineers and engineering geologists, including 9 with over 20 years of experience in landslide and rockfall mitigation. Six Staff Consultants, each with decades of experience, are available to provide expertise when needed. The firm also has an additional five support staff members who perform technician, drafting, accounting, word processing, and other office duties. Staff turnover is exceptionally low. To serve our clients and reduce travel costs, we have recently implemented the video conferencing and remote presentation software, GoTo Meeting. The firm has a well-stocked geotechnical and geology library and extensive computer software. LT maintains several vehicles equipped with Tripmasters and field equipment including digital cameras, ruggedized laptop computers and tablets, hand-held GPS units, and laser rangefinders.

4.3 ORAL PRESENTATION AND INTERVIEW

Key team members of the Landslide Technology team are prepared to complete an oral presentation and interview in Helena, Montana.

TABLE 2: LIST OF AVAILABLE TIME FOR KEY PROJECT STAFF

Company	Key Staff	2015	2016	2017
Landslide Technology	Darren Beckstrand, C.E.G.	40%	80%	80%
Landslide Technology	Brent Black, C.E.G.	35%	50%	60%
Landslide Technology	Ben George, C.E.G., P.E.	40%	60%	70%
Landslide Technology	Larry Pierson, C.E.G.	20%	30%	30%
Paul D. Thompson	Paul Thompson	30%	50%	50%
DA Stanley Consulting	David Stanley, C.P.G.	70%	80%	80%
Geographic Comm. Systems	John Waterman	50%	70%	70%

5. Cost Proposal

- 5.1 Submittal of Proposed Budget

5 COST PROPOSAL

Our Cost Proposal is itemized in various formats for the following breakdowns:

1. Each Task and MDT and Federal Fiscal Year Breakdowns (Breakdown 1)
2. Each Expense Category (Breakdown 2)
3. Each Deliverable and Meeting as specified (Breakdown 3)
4. Number of Hours (Breakdown 4)
5. Hourly and OH Rates (Breakdown 2)
6. All other direct and indirect costs, including profit (Breakdown 2)
7. Overhead Rate and Proof (ODOT Letter)
8. Airfare Breakdown

BREAKDOWN 4: HOURS

	Task Description	D. Vessely	B. Black	D. Beckstrand	B. George	L. Pierson	Project Lvl	Staff Lvl	Drafter	Secretary
1	**Literature Review and Kick-off Mtg**									
1	1a Literature Review		8	4	4			8		
1	1b Kick-off Mtg		16	16	16	16				
1	1c IT Infrastructure Mtg			4						
1	Contract Admin	8	2	2						
1	Mtg Minutes, Agenda			2	4					
1	Task Report		2	2	8	2				
1	Monthly Progress Reports (3 Mos)			9						6
1										
2	**Assess Completed Projects**									
2	Visit 12 Sites		82	82	82			40		
2	Task Report		4	4	16			16		
2	Monthly Progress Reports (3 mos)			9						6
2										
3	**Develop and Refine MDT Rockfall Rating Criteria**									
3	Develop LOS/Perf Measures		2	8	12					
3	Develop Condition States		2	8	12					
3	Qualitative Risk		2	8	12					
3	Revise Rating Criteria After Task 4		2	8	12					
3	Task Report		2	8	12	16				
3	Monthly Progress Reports (3 mos)	2		9						6
3										
4	**Assess Rockfall Sites**									
4	Create Field Forms		2	4	4			40		
4	Coordinate with MDT Staff		8		4			20		
4	Perform Ratings		20	40	60		200	200		
4	Transfer Data to Digital Format			4			16	16		100
4	Task Report		10	10	20	4		40	40	
4	Monthly Progress Reports (3 mos)	3		9						6
4	Monthly Progress Reports (1 mos)			3						2
4										
5	**Determine Current Critical States**									
5	Develop mitigation element costs		8		8					
5	Develop mitigation measures and quantities (30 sites)		16		24		90			
5	Cost estimates for ancillary efforts		8		16					
5	Finalize Conceptual Cost Estimates		4		8		8			
5	Task Report		8	8	16	4	24			
5	Monthly Progress Reports (2 mos)	1		6						4
5										
6	**Develop Cost/Benefits**									
6	Determine Maintenance Costs		4	4	8			16		
6	Estimate highway user costs		2	4	12			12		
6	Estimate safety risk		2	4	12			12		
6	Aggregate Costs/Benefits		2	4	12			12		
6	Task Report		4	8	12	4		8		
6	Monthly Progress Reports (2 mos)			6						4
6										
7	**Evaluate Compatibility**									
7	Review current IT infrastruture			4						
7	ID additional req's for TAM Plan (Hold Mtg in Helena)			40						
7	Update GCS review			2						
7	Task Report		4	8	4					
7	Monthly Progress Reports (1 mo)			3						2
7										
8	**Reports and Meetings**									
8	Prepare Draft Final Report	4	18	24	40	8				20
8	Prepare Final Final Report		6	6	6					8
8	Prepare Research Summary Report		2	4	4					
8	Prepare Implementation Report	2	4	16	12	2				
8	Prepare Performance Measure Report	2	4	8	8	2				
8	Final Oral Presentation		16	16	16					
8	Implementation Meeting		8	8	8					
	Total Hours	**22**	**284**	**436**	**504**	**58**	**338**	**440**	**40**	**164**
	Time Percentage	**0.96%**	**12.42%**	**19.07%**	**22.05%**	**2.54%**	**14.79%**	**19.25%**	**1.75%**	**7.17%**

OVERHEAD RATE AND PROOF

Oregon Department of Transportation
Audit Services

Central Services Division – MS 52, 355 Capitol Street NE,Salem, OR 97301 Telephone: 503-986-3213

September 18, 2014

TO: Chaye Bookey, ODOT Contract Administrator

FROM: Margaret Cole, External Audit Manager

SUBJECT: Cornforth Consultants, Inc. Schedule of Indirect Cost Rate Fiscal Year Ended December 31, 2013

We reviewed the Independent Auditor's Report issued by Anderson Zurmuehlen (AZ) related to Cornforth Consultant's Indirect Cost Rate for the above referenced fiscal year (see attachment) and performed limited desk review procedures.

Based on reviewing all information provided, we made additional adjustments on executive unallowable compensation. We are issuing this memo recommending Cornforth Consultant's Indirect Cost Rate for the fiscal year ended December 31, 2013 at 168.21% of direct labor (rate includes 0.13% Facilities Cost of Capital).

This was not a cognizant review. However, ODOT External Audit reserves the right to perform a cognizant review or audit if ODOT's Procurement Office requires. Any other entity contracting with the firm is responsible for determining the acceptability of the Indirect Cost Rate.

If you have any questions, please feel free to call me at 503-986-3213 or via email at Margaret.A.COLE@odot.state.or.us

Attachment

Cc: Consultants

Note that Cornforth Consultants, Inc. is Landslide Technology's parent company.

AIRFARE BREAKDOWN: HOURS

Task	Number of R/T Airfares	Personnel*
1: Kick-off Meeting	4	BAB, DLB, BAG, LAP, DS
2: Assess Completed Projects	3	BAB, DLB, BAG
4: Assess Rockfall Sites	6	DLB, BAG, Project Level x2, Staff Level x2
7: Evaluate TAM Compatibility	1	DLB, DS, PT
8: Reports and Meetings	3	BAB, DLB, BAG, DS, PT
TOTAL	**17**	

BAB – Brent Black

DLB – Darren Beckstrand

BAG – Ben George

LAP – Larry Pierson

DS – Dave Stanley (Reimbursable costs covered in Lump Sum)

PT – Paul Thompson (Reimbursable costs covered in Lump Sum)

Commitment Letters

- Paul D. Thompson
- David Stanley
- Geographic Communication Systems

Paul D. Thompson
Management Systems • Engineering Economics
17035 NE 28th Place, Bellevue, WA 98008
425-224-5443; pdt@pdth.com

17 February, 2015

Darren Beckstrand, C.E.G, C.P.G
Senior Associate Geologist
Landslide Technology
10250 SW Greenburg Rd, Suite 111
Portland, OR 97223

Re: Letter of intent
State of Montana RFP 15-3059V, Rockfall Hazard Rating Process Assessment

Dear Darren:

I am pleased to be a sub-consultant on the Landslide Technology team in response to the above-named Request for Proposals. I fully intend to provide the work as described in our Proposal should Landslide Technology become the Prime Consultant.

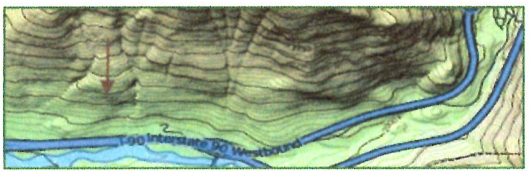
I am looking forward to the prospect of working with you on this important project.

Sincerely,

Paul Thompson

Paul D. Thompson

DA Stanley Consulting
Bellingham, WA



February 16, 2015

Mr. Darren Beckstrand
Landslide Technology, a Division of Cornforth Consultants, Inc.
10250 Southwest Greenburg Road Suite #111
Portland, OR 97223

Re: Letter of Intent

Dear Mr. Beckstrand,

I intend to provide agreed-upon sub-consultant services to Landslide Technology for the work described in the Request for Proposal No. 15-3059 from the State of Montana dated February 3, 2015, if Landslide Technology becomes the prime Consultant.

Very Truly Yours,

D.A. Stanley

David Stanley

February 24, 2105

To Whom it May Concern,

GCS confirms that it intends to provide work as described in the proposal should Landslide Technology become the prime consultant for the Montana Department of Transportation.
GCS has a proven track record of successfully designing, developing and deploying solutions for the State of Montana under the Master Contract for IT Services.

GCS is currently working with Montana Department of Transportation on a Highway Economic Analysis Tool (HEAT2), to allow quick and consistent economic analysis of road improvement projects.

We proudly maintain a long term relationship with the State of Montana, with a history of going above and beyond to achieve contract success and client satisfaction. Our well-rounded professional team has all the key skills needed to be a successful sub consultant to Landslide Technology.

Thank you for your consideration. Please do not hesitate to contact me with any questions or concerns.

Sincerely,

Michael W. Beltz
Vice President of Sales and Marketing
GCS
115 South Fourth St. West
Missoula, MT 59801-27821

Client Reference Questionnaires

- Mr. John Sharkey, MDT
- Mr. Stephen Hay, ODOT
- Ms. Lynn White, ITD

APPENDIX C: REFERENCE QUESTIONNAIRE

This is a reference questionnaire for a research project titled ROCKFALL HAZARD RATING SYSTEM ASSESSMENT for which the Montana Department of Transportation (MDT) has issued a request for proposal. The scope of this project is to provide an evaluation of the existing Rockfall Hazard Rating System (RHRS) system and recommend updates to it as necessary to a more effective asset management system that can be used as a planning tool to guide MDT on rockfall mitigation projects.

You have been sent this questionnaire to provide a reference for the consultant responding to MDT's request.

The individual responding to this questionnaire must be a responsible party of the organization for which the services were provided and have comprehensive knowledge about the services provided.

If there are problems with this survey or an alternate format is needed, please contact:

Procurement Officer – Rick Dorvall

Address:
State Procurement Bureau
General Services Division
Department of Administration
Room 165, Mitchell Building
125 North Roberts Street
Helena, MT 596014558

Part 1: You and Your Organization

The individual responding to this must be a responsible party of the organization for which the services were provided and have comprehensive knowledge about the services provided.

1. Please list your contact information:
   John Sharkey, MDT Geotechnical Section, Montana Dept of Transportation, Helena MT, 2701 Prospect Ave.
   JSharkey@Mt.gov or 406/444-6286
2. Please list your title:
   Great Falls District Geotechnical Specialist

Part 2: Consultant Information

Please answer the following questions about the consultant for which you are providing a reference.

1. List the firm or individual you are providing this reference for:
   Landslide Technology / Brent Black, Ben George, Darren Beckstrand
2. List the consultant's dates of service for your project(s):
   Multiple projects over several years beginning in Appx 2005. Most Recent began in 2013 And is nearing completion of Contract Documents for Letting
3. List the services that were provided by the consultant:
   Soil Slope & Rock Slope Hazard & Failure Mitigation design, including Recommendations Plan set preparation, Specifications, Contract PREPARATION, Modeling, evaluation, Engineering & Contract Consultation & oversight.
4. List the skills that were necessary to perform the services provided:
   Expertise in All of the Above plus Communication facilitation Attention to detail, follow-up w/ Very unique & Specific Knowledge set of Slope failure mechanisms, Relative hazards, And Mitigation techniques.
5. Did the consultant provide skilled and qualified staff to perform the work?
   If no, please explain. Absolutely
6. Were there any changes in key personnel? No
   If yes, please explain the situation (including who requested the change(s), did change(s) affect the project, and how were any issues resolved), and describe any related issues.
7. Are you familiar with the key project personnel identified in the email requesting your reference?
   If yes, please indicate which person(s) and describe how they were able to facilitate successfully completing the contracted project(s). Yes. Brent Black, Darren Beckstrand & Ben George. I dont know exactly how to describe how they were Able to facilitate Successfully completing the contracted Projects. All I Know is that they continue to do So And I couldnt have... And they're never failed to meet A deadline that I'm Aware of - After forming A professional relationship with RPA, Inc, multiple site trips to evaluate target mitigation sites, nearly continuous Communication with MDT staff, And Numerous hours of evaluation & modeling, drafting, spec. Writing And Consideration of multiple elements, including those outside their areas of expertise, they have completed An impressively Comprehensive set of plans for the D-3 Rockfall Mitigation project.

Part 3: Service Characteristics

Please take a few minutes to complete these questions on the quality of service the consultant provided. We welcome your feedback and appreciate your honesty.

1. Please select your criteria for choosing this consultant (select all that apply).

   a. Industry/marketplace knowledge

   b. Length of time in business

   c. Consultative capabilities

   d. Technology and tools provided

   e. Personal referral

   f. Lowest rate

   g. Responsiveness to requests

   h. Value added services

   i. Other (please specify)

Please add any additional comments or concerns below.

They ~~would~~ continue to be my Consultant of choice for Any slope failure or rock fall hazard project.

2. Please rate the following for the consultant:

Consultant's Work Criteria	Excellent	Above Average	Average	Below Average	Poor	N/A
Their work was timely.	X					
Their work was accurate	X					
They kept you informed of progress and made efforts to maintain contact regarding progress	X					
They addressed your questions and concerns	X					
The quality of the responses to your questions and concerns	X					
The timeliness of the responses to your needs	X					
Their knowledge level	X					
The products and services they provided met your objectives	X					
Their writing ability was sufficient to provide quality products		X				
They delivered the project within contract budget		X				
They were easy to work with	X					

Please add any comments or concerns below. An average or below rating should indicate an explanation in this section. Did the consultant have an opportunity to correct the problem and, if so, did they?

3. Overall, what is your assessment of the following:

Consultant's Work Criteria	Excellent	Above Average	Average	Below Average	Poor	N/A
Performance	X					
Final Product (s)	X					

Please add any comments or concerns below. An average or below rating should indicate an explanation in this section.

4. Were there any project extensions granted? None needed
If yes, please explain why and at whose request.

5. Were there any conflicts, disputes, or other problems? no
If yes, were they reported early and were they managed well? How were they resolved? Were you satisfied that the resolution was fair to both parties?

Part 4: Follow-Up

1. To what extent was the consultant's product implemented? nearly 100% on All Complete Projects to date

2. Do you feel you received benefits that correspond to the project cost? YES
   Please explain why or why not. They provide exceptional service & expertise.

3. If given a choice, would you hire the consultant again? Absolutely, without hesitation.
   Please explain why or why not. – I already have...

4. Any additional comments?

APPENDIX C: REFERENCE QUESTIONNAIRE

This is a reference questionnaire for a research project titled ROCKFALL HAZARD RATING SYSTEM ASSESSMENT for which the Montana Department of Transportation (MDT) has issued a request for proposal. The scope of this project is to provide an evaluation of the existing Rockfall Hazard Rating System (RHRS) system and recommend updates to it as necessary to a more effective asset management system that can be used as a planning tool to guide MDT on rockfall mitigation projects.

You have been sent this questionnaire to provide a reference for the consultant responding to MDT's request.

The individual responding to this questionnaire must be a responsible party of the organization for which the services were provided and have comprehensive knowledge about the services provided.

If there are problems with this survey or an alternate format is needed, please contact:

Procurement Officer – Rick Dorvall

Address:
State Procurement Bureau
General Services Division
Department of Administration
Room 165, Mitchell Building
125 North Roberts Street
Helena, MT 596014558

Part 1: You and Your Organization

The individual responding to this must be a responsible party of the organization for which the services were provided and have comprehensive knowledge about the services provided.

1. Please list your contact information:

   Stephen Hay
   Oregon Department of Transportation
   Region 1 Geo/Environmental Unit
   Portland, Oregon 97209
   503-731-8306 (direct)
   503-780-2354 (mobile)

2. Please list your title:

   Engineering Geologist

Part 2: Consultant Information

Please answer the following questions about the consultant for which you are providing a reference.

1. List the firm or individual you are providing this reference for:

   Cornforth Consultants (Landslide Technology's parent company)

2. List the consultant's dates of service for your project(s):

   August 2011 - Present

3. List the services that were provided by the consultant:

   Technical review of rock slope designs by ODOT Engineering Geologists
   Rock slope design

4. List the skills that were necessary to perform the services provided:
   Expertise in structural geology analysis and design.

5. Did the consultant provide skilled and qualified staff to perform the work? **Yes**
   If no, please explain.

6. Were there any changes in key personnel? **No**
   If yes, please explain the situation (including who requested the change(s), did change(s) affect the project, and how were any issues resolved), and describe any related issues.

7. Are you familiar with the key project personnel identified in the email requesting your reference? **Yes**
   If yes, please indicate which person(s) and describe how they were able to facilitate successfully completing the contracted project(s).

   The individual requesting the reference is not part of the key project personnel on my recent projects however we have worked together previously on other projects.

Part 3: Service Characteristics

Please take a few minutes to complete these questions on the quality of service the consultant provided. We welcome your feedback and appreciate your honesty.

1. Please select your criteria for choosing this consultant (select all that apply).

    a. Industry/marketplace knowledge

    b. Length of time in business

    c. Consultative capabilities

    d. Technology and tools provided

    e. Personal referral

    f. Lowest rate

    g. Responsiveness to requests

    h. Value added services

    i. Other (please specify)

    Please add any additional comments or concerns below.

2. Please rate the following for the consultant:

Consultant's Work Criteria	Excellent	Above Average	Average	Below Average	Poor	N/A
Their work was timely.	X					
Their work was accurate		X				
They kept you informed of progress and made efforts to maintain contact regarding progress	X					
They addressed your questions and concerns	X					
The quality of the responses to your questions and concerns	X					
The timeliness of the responses to your needs	X					
Their knowledge level	X					
The products and services they provided met your objectives	X					
Their writing ability was sufficient to provide quality products		X				
They delivered the project within contract budget	X					
They were easy to work with	X					

Please add any comments or concerns below. An average or below rating should indicate an explanation in this section. Did the consultant have an opportunity to correct the problem and, if so, did they?

3. Overall, what is your assessment of the following:

Consultant's Work Criteria	Excellent	Above Average	Average	Below Average	Poor	N/A
Performance	X					
Final Product (s)	X					

Please add any comments or concerns below. An average or below rating should indicate an explanation in this section.

4. Were there any project extensions granted? **Yes**
   If yes, please explain why and at whose request.
   Project extensions were granted by ODOT so that the consultant could perform additional work unanticipated in the original scope of work.

5. Were there any conflicts, disputes, or other problems? **No**
   If yes, were they reported early and were they managed well? How were they resolved? Were you satisfied that the resolution was fair to both parties?

Part 4: Follow-Up

1. To what extent was the consultant's product implemented?
   Consultant products have always been implemented on my projects.

2. Do you feel you received benefits that correspond to the project cost? **Yes**
   Please explain why or why not.
   I have always received a high quality product from the consultant and their billable costs always remain within the scope of services and the overall project budget.

3. If given a choice, would you hire the consultant again? **Yes**
   Please explain why or why not.

   The consultant provides a high level of technical expertise and has the personnel to meet the objectives and timelines of proposed projects.

4. Any additional comments?

APPENDIX C: REFERENCE QUESTIONNAIRE

This is a reference questionnaire for a research project titled ROCKFALL HAZARD RATING SYSTEM ASSESSMENT for which the Montana Department of Transportation (MDT) has issued a request for proposal. The scope of this project is to provide an evaluation of the existing Rockfall Hazard Rating System (RHRS) system and recommend updates to it as necessary to a more effective asset management system that can be used as a planning tool to guide MDT on rockfall mitigation projects.

You have been sent this questionnaire to provide a reference for the consultant responding to MDT's request.

The individual responding to this questionnaire must be a responsible party of the organization for which the services were provided and have comprehensive knowledge about the services provided.

If there are problems with this survey or an alternate format is needed, please contact:

Procurement Officer – Rick Dorvall

Address:
State Procurement Bureau
General Services Division
Department of Administration
Room 165, Mitchell Building
125 North Roberts Street
Helena, MT 596014558

Part 1: You and Your Organization

The individual responding to this must be a responsible party of the organization for which the services were provided and have comprehensive knowledge about the services provided.

1. Please list your contact information:
   Lynn White, P.E.
   Idaho Transportation Department, District 4
   216 South Date St.
   Shoshone, ID 83352
   208-886-7834

2. Please list your title:

   District 4 Materials Engineer

Part 2: Consultant Information

Please answer the following questions about the consultant for which you are providing a reference.

1. List the firm or individual you are providing this reference for:
   Landslide Technology

2. List the consultant's dates of service for your project(s):
   September 29, 2011 to present

3. List the services that were provided by the consultant:
   a. Evaluated conditions of existing rock and soil cut slopes.
   b. Prepared representative cross sections for existing landslide.
   c. Prepared geotechnical recommendation for design and construction for cut slopes and landslide mitigation.
   d. Presented evaluations and recommendations in formal written reports and presentations to stakeholders.

4. List the skills that were necessary to perform the services provided:
   Skills utilized for this project include geologic mapping, determining Rock Mass Classification, logging test pits and borings, mapping rock discontinuities, and preparing stereonets of discontinuities of proposed cuts and excavations.

5. Did the consultant provide skilled and qualified staff to perform the work?
   If no, please explain. Yes

6. Were there any changes in key personnel?
   If yes, please explain the situation (including who requested the change(s), did change(s) affect the project, and how were any issues resolved), and describe any related issues. No

7. Are you familiar with the key project personnel identified in the email requesting your reference?
   If yes, please indicate which person(s) and describe how they were able to facilitate successfully completing the contracted project(s).

   I have worked with George Machan, P.E., and Darren Beckstrand, C.E.G., C.P.G for the three Professional services agreements on the Galena Summit Slide in South Central Idaho. Mr. Machan and Mr. Beckstrand have been responsive to the technical requirements of the Idaho Transportation Department. They are sensitive to the requirements of Federal Land agencies. They have the ability and skill to use field time optimally. They provide written reports that are easy to understand by both geotechnical and regulatory agency personnel.

Part 3: Service Characteristics

Please take a few minutes to complete these questions on the quality of service the consultant provided. We welcome your feedback and appreciate your honesty.

1. Please select your criteria for choosing this consultant (select all that apply).

    a. <u>Industry/marketplace knowledge</u>

    b. <u>Length of time in business</u>

    c. <u>Consultative capabilities</u>

    d. <u>Technology and tools provided</u>

    e. Personal referral

    f. Lowest rate

    g. <u>Responsiveness to requests</u>

    h. Value added services

    i. Other (please specify)

    Please add any additional comments or concerns below.

2. Please rate the following for the consultant:

Consultant's Work Criteria	Excellent	Above Average	Average	Below Average	Poor	N/A
Their work was timely.		X				
Their work was accurate	X					
They kept you informed of progress and made efforts to maintain contact regarding progress	X					
They addressed your questions and concerns		X				
The quality of the responses to your questions and concerns		X				
The timeliness of the responses to your needs		X				
Their knowledge level	X					
The products and services they provided met your objectives	X					
Their writing ability was sufficient to provide quality products	X					
They delivered the project within contract budget		X				
They were easy to work with	X					

Please add any comments or concerns below. An average or below rating should indicate an explanation in this section. Did the consultant have an opportunity to correct the problem and, if so, did they?

3. Overall, what is your assessment of the following:

Consultant's Work Criteria	Excellent	Above Average	Average	Below Average	Poor	N/A
Performance						
Final Product (s)	X					

Please add any comments or concerns below. An average or below rating should indicate an explanation in this section.

The recommendations and exhibits in the reports prepared by Landslide Technology will be used in the design and construction for landslide mitigation and roadway widening projects on a mountain pass. These reports were written so that designers and construction personnel can use the information therein as the projects are designed and constructed.

4. Were there any project extensions granted?
If yes, please explain why and at whose request.

Yes, funding issues within Idaho Transportation Department necessitated the extension of two agreements. This was a no fault of Landslide Technology.

5. Were there any conflicts, disputes, or other problems?
If yes, were they reported early and were they managed well? How were they resolved? Were you satisfied that the resolution was fair to both parties?

No disputes or problems have been encountered during any of the Professional Services agreements.

Part 4: Follow-Up

1. To what extent was the consultant's product implemented?
   ITD has not received funding to design or construct the projects at Galena Summit Slide area.

2. Do you feel you received benefits that correspond to the project cost?
   Please explain why or why not.

   Yes, the information provided by Landslide Technology will likely reduce risks to both Contractors and ITD. Contractors will have enough information to bid accurately. The probability of Construction claims due to change in conditions is lowered.

3. If given a choice, would you hire the consultant again?
   Please explain why or why not.

   I would hire Landslide Technology again. The personnel are professional and experienced in geology and geotechnical engineering. My impression is that the personnel in this firm really enjoy their work. They have high ethical standards.

4. Any additional comments?

Work Examples

- D3 I-15 Rockfall Mitigation Design
- I-90 Rockfall Mitigations QAQC
- Enterprise Transportation Asset Management Synthesis and Work Plan Final Report

See Contents of CD for Work Examples

Resumes

DARREN L. BECKSTRAND, SENIOR ASSOCIATE GEOLOGIST

Education

M.S. in Geology, Portland State University, Portland, Oregon
B.S. in Geology, Portland State University, Portland, Oregon

Registration

Certified Engineering Geologist – Oregon, Washington
Registered Geologist – Oregon, Washington, Idaho, Wyoming, Alaska

Societies

Member and Past-Chair, Association of Engineering Geologists, Oregon Section
Member, American Institute of Professional Geologists

Honors

Vice-Chair, Subcommittee on Geotechnical Asset Management, National Academy of Science, TRB

Professional Career

2000-present Landslide Technology, Portland, Oregon; Senior Associate Geologist

Relevant Experience

Mr. Beckstrand has over 15 years of engineering geology experience working on transportation and infrastructure projects in Montana and throughout the western United States. His areas of expertise include rockfall hazard evaluations, rockfall and landslide mitigation, site investigations and instrumentation, geologic hazards, and geotechnical asset management. Representative projects include the following:

Unstable Slope Management Program for Federal Lands, Gifford Pinchot National Forest, Washington. Geotechnical Project Manager for the implementation of the Unstable Slope Management Program (USMP) rating system for 125 sites along rockfall and landslide prone roadways in the Gifford Pinchot National Forest. Assisted Western Federal Lands Highway Division (WFLHD) in the development of the USMP rating forms through meetings and coordination with Federal Land Management Agency representatives. Assisted in the development of USMP deliverables including data analysis and mapping.

Rockfall Hazard Rating System Implementation, Statewide, Montana. As Project Engineering Geologist, Mr. Beckstrand planned and participated in the field efforts of a statewide implementation of the Rockfall Hazard Rating System (RHRS). Designed a custom Microsoft Access database for the preliminary and detailed rating phases of the RHRS. The database incorporated crucial features, such as digital photograph management and detailed rating score calculations, to economize the field effort. GIS maps and data products were also provided. Over 2,500 potential hazardous slopes were examined, with over 750 of these examined in the field by Mr. Beckstrand.

Alaska Statewide Geotechnical Asset Management Program, Alaska. Senior Engineering Geologist responsible for assisting with the development and implementation of the statewide Geotechnical Asset Management (GAM) program for 750 slopes in the Alaska State Highway System to provide AKDOT&PF with data on the overall performance and condition of rock and soil slopes. When completed, the GAM program will include both hazard and risk assessments, condition surveys, service life predictions and condition indices for all unstable slopes throughout the highway system. As part of the agency's overall

Transportation Asset Management initiative, the GAM program will provide performance information used to guide Alaska's highway corridor investment strategies.

I-90 MP24 Rockfall Mitigation QA/QC, St. Regis, Montana. Project Manager and Senior Engineering Geologist responsible for rockfall mitigation plan review and construction engineering services in conjunction with a Design Build (DB) contract released by MDT to mitigate rockfall issues. Provided assistance with the DB RFP preparation, evaluation support during review of DB technical proposals, and on-site technical services for design implementation and construction of the rockfall mitigation measures for two cut slopes between mile posts 24.0 and 24.8 on westbound Interstate 90. Provided project oversight and technical recommendations to MDT during construction and review of a geotechnical design report, plans and specifications, shop drawings, and other construction submittals.

Badrock Canyon Rock Monitoring, Columbia Falls, Montana. Large tension cracks were present above a narrow two lane highway in northwestern Montana. This section of road is the last remaining portion of highway that does not meet modern safety standards in the heavily traveled route between Kalispell and Glacier National Park. In order to fully characterize the rock mechanics above the roadway and define possible slope stability issues, a crack monitoring program was initiated. Mr. Beckstrand implemented a monitoring plan that included continued reading of existing anchor points with a tape extensometer, initiating a terrestrial 3-D Lidar scan of the cliff face, and the installation of three continuously read vibrating wire crackmeters. Each method provides differing levels of precision, with the crackmeters providing a precision of approximately 0.02 mm.

Looking Glass Road Landslide and Rockfall Investigation, East Glacier, Montana. Project Engineering Geologist responsible for performing field mapping, technical support during landslide explorations, rockfall modeling and mitigation design for multiple landslide and rockfall sites on Route 49 near Glacier National Park. Provided field training on the installation of vibrating wire piezometers for subcontractors and programmed, installed, and tested dataloggers for 19 installed piezometers.

Galena Summit Slide Mitigation and Rock Slope Cut Design, SH-75, MP 156.7, Blaine County, Idaho. Project Engineering Geologist for the geotechnical investigation and evaluation of mitigation options for the SH-75 Galena Summit landslide and rock cuts for the Idaho TD. The geological reconnaissance included 12 different rock slope areas and involved working with criteria from the Forest Service's Sawtooth National Recreation Area (SNRA). Work tasks included structural mapping and stability analyses of rock slopes, new cut design, roadway realignment of a through-cut, and development of 2-3 mitigation options for ITD to consider. The project dealt with both high and low quality rock cuts.

Federal Highway Administration (FHWA) Rockfall Catchment Area Modeling. As part of the development of a national training course for the Rockfall Catchment Area Design Guide, Mr. Beckstrand assisted with the assembly of rockfall models to compare field rockfall run-out tests with computer rockfall simulations. Multiple configurations, including slope height, slope angle, and ditch angles were considered in the comparisons.

Going-to-the-Sun Road (GTSR), Rockfall Hazard Rating System Implementation, Glacier National Park, West Glacier, Montana. The National Park Service is rehabilitating the historic Going-to-the-Sun Road in Glacier National Park. Part of the rehabilitation included addressing the hazardous rock slopes common along the roadway. Mr. Beckstrand was involved with all the steps of providing hazard evaluations, conceptual and final designs and cost estimates, and the preparation of plans and specifications for the most hazardous rock slopes between 2004 and 2009. He also arranged a fast-track custom implementation of the

RHRS and modified the RHRS database for utilization and synchronization by multiple raters. The database design incorporated communication with ArcView GIS software for real-time display of collected data. Provided office and field training on the application of the RHRS and the use of the database system.

US 26 Rockfall Hazard Rating System Implementation, Irwin, Idaho. Project Engineering Geologist responsible for assisting with the implementation of the Rockfall Hazard Rating System (RHRS) for a 13-mile section of US Highway 26 in eastern Idaho. Fifteen rockfall-prone sites were evaluated and scored, and conceptual mitigation designs were formulated while on site. Mitigation cost estimates were formulated which allowed ITD to evaluate the slopes based on hazard, mitigation cost, and cost to hazard ratio.

Highway 2 Rockfall, Libby, Montana. Staff Geologist assigned to the field investigation, data analysis, and design of mitigation measures at a major rockfall area west of Libby Montana. The field investigations included statistical rock mapping, formulating conceptual and final design measures, and cross section measurement for rockfall modeling. Mitigation measures included scaling, blast scaling, rock bolts, shotcrete, and cable nets, all of which were constructed in 2007.

I-15 Rockfall Mitigation Design, Helena to Great Falls, Montana. Portions of Interstate 15 between Helena to Great Falls are constructed adjacent to a number of high rock slopes and road cuts. MDT aims to reduce rockfall hazards at key slopes within these corridors that are posing a hazard to the public. Mr. Beckstrand was Project Geologist for a Phase I geotechnical evaluation of the identified sites. Work tasks included gathering design information for conceptual mitigation options including the anticipated design quantities and an evaluation of the constructability and hazard reduction for each option. Office analyses were performed to complete preliminary design of each option and to prepare a decision matrix for MDT's use in evaluating the options. Phase II involved detailed design work of the mitigation options selected by MDT.

Rockfall Hazard Rating System Database Design and Instruction, Statewide, Virginia. Mr. Beckstrand was Project Engineering Geologist responsible for the design of a database for the collection of RHRS rating data. He provided field training for both the database operation and rating implementation for Virginia DOT personnel.

South Tongass Highway Rockfall, Ketchikan, Alaska. During construction of road improvements, the failure of a new rock cut and landslide required on-call services during construction. Mr. Beckstrand performed reconnaissance and located areas for rock bolt placement to mitigate against future potential failures. At another area of the construction project, the slope failure prompted a re-design of a rock cut. Mr. Beckstrand performed rock slope stability modeling for different slope configurations and designed pattern rock bolt placement for two of the design options.

Sunset Highway (US26) Rockslide, Portland, Oregon. Project Engineering Geologist as part of an emergency effort in response to a rockslide that closed lanes of the major highway exiting downtown Portland. The failure required emergency work to scale the remaining hazardous rocks from the hillside in order to open the road to traffic. As part of the permanent mitigation design process, Mr. Beckstrand provided rockfall modeling to ensure that potential rockfall would be retained by the planned control measures. During construction, he served as the Owner's representative and provided QA/QC during the anchor and draped Tecco net installation.

BRENT A. BLACK, SENIOR ASSOCIATE GEOLOGIST

Education

M.S. in Geology, Kent State University, Kent, Ohio
B.S. in Geology, West Virginia University, Morgantown, West Virginia

Registration

Certified Engineering Geologist – Oregon, Washington
Registered Geologist – Oregon, Washington, Idaho, Utah
Licensed Hydrogeologist - Washington

Societies

Member and Past-Chair, Association of Engineering Geologists, Oregon Section

Honors

Panel Member, National Cooperative Highway Research Program (NCHRP) Project 24-35, Guidelines for Certification and Management of Flexible Rockfall Protection Systems, 2010 to present
Member, Subcommittee on Rockfall Management, National Academy of Science, TRB
Member, Subcommittee on Geotechnical Asset Management, National Academy of Science, TRB

Professional Career

1993-present Landslide Technology, Portland, Oregon; Senior Associate Engineering Geologist
1991-1992 Eckstein & Associates, Kent, Ohio; Geologist

Relevant Experience

Mr. Black has over 23 years of engineering geology experience, much of this dedicated to the investigation, design, and construction management of rockfall mitigation projects in the western United States. His areas of expertise include rockfall evaluations, rockfall and slope stability design mitigation, site investigation and instrumentation, geologic hazards, landslide dewatering, and construction quality assurance. Representative projects include the following:

I-15 (D3) Rockfall Mitigation Design, Helena to Great Falls, Montana. Portions of Interstate 15 between Helena and Great Falls were constructed adjacent to a number of high rock slopes and road cuts. MDT sought to reduce rockfall hazards at 15 slope sections within the corridor that were posing a hazard to the public and increased maintenance efforts. Mr. Black is Project Manager for the D3 rockfall mitigation evaluations that have included development of conceptual mitigation options for all 15 sites (30% design) and final design and PS&E delivery for nine of the 15 sites. Work tasks have included field reconnaissance and geologic mapping to collect relevant rockfall and structural data, development of conceptual and final mitigation options to reduce rockfall hazards, and an evaluation of the constructability for each option. Office analyses were performed to complete preliminary design of each option and to prepare a decision matrix for MDT's use in evaluating the options. PS&Es for six of the nine rockfall mitigation sites were delivered. LT is currently developing the final design package for the remaining three rockfall mitigation sites.

US 2 Black Butte Rockfall, Havre, Montana. Mr. Black provided technical guidance to MDT for the development of rockfall mitigation designs for a rock cut just west of Havre on US Highway 2. The work included a site visit with MDT personnel to reconnaissance the slope, interview MDT personnel to develop an historical understanding of rockfall events, and development of several preliminary rockfall mitigation options

and recommendations that lead to final design and project development. Additional tasks included developing a memo and providing technical assistance to MDT during the development phase of this work.

Libby Rockfall Investigation and Mitigation Design – Highway 2, Libby, Montana. Project Manager for a large wedge failure extending approximately 130 feet into a rock slope along U.S. Highway 2 west of Libby. Work tasks included performing detailed geologic and rock structural mapping, rockmass characterization, stability analyses, computer rockfall simulations, and development of rockfall mitigation measures. Coordinated and managed the mitigation construction work that included trim blasting and hand scaling efforts; installation of 58 rock bolts and 10 rock dowels; shotcrete application; placement of draped ring nets, and the construction of 250 feet of a twelve foot tall, 184 ft-ton flexible rockfall barrier.

I-15 Stickney to Hardy Creek Rockfall, Cascade, Montana. Mr. Black was Project Manager for a geotechnical evaluation of the rock slope near mile point 245.6 along I-15, which had experienced a major rockfall event. Work tasks included gathering design information for different mitigation options including the anticipated design quantities and an evaluation of the constructability and hazard reduction for each option. Office analyses were performed to complete preliminary design of each option and to prepare a decision matrix for MDT's use in evaluating the options. A preliminary design report was prepared. Recommendations where incorporated into final design and PS&E for the project.

Weeksville West Project – Rock Cut and Reinforcement, State Route 200, Plains, Montana. Project Engineering Geologist for the design and installation of 127 rock bolts and 50 rock dowels during the construction of four large rock cut slopes associated with the SR 200 highway improvement project. Provided full-time technical assistance to MDT to identify the rock bolt locations, lengths and orientations to provide additional reinforcement to rock blocks within the four cut slopes. Rock bolt location and scaling recommendations were made following the blasting of each lift so the installations could be made from the temporary excavation benches.

Highway 93 Lakeside Rockfall - Construction Services, Lakeside, Montana. Provided full time on-site observations of the Contractor's scaling, blasting, and rock bolting and assisted the MTD Project Manager on technical evaluations and acceptance of completed work. Services included technical oversight of trim blasting; guiding and documenting rock bolt installation; determining additional rock bolt and rock dowel locations; and assisting with the installation of instrumentation monitoring points.

Going-to-the-Sun Road (GTSR) Rockfall Mitigation, West Glacier, Montana. The National Park Service rehabilitated the historic Going-to-the-Sun Road in Glacier National Park. Part of the rehabilitation included addressing hazardous rock slopes common on the roadway. Mr. Black acted as Senior Engineering Geologist for this WFL multi-phase project that included implementation of the Rockfall Hazard Rating System (RHRS), field reconnaissance, geologic investigation, rockfall evaluation, conceptual and final rockfall mitigation designs, cost estimating, and the preparation of plans and specifications for the most hazardous rock slopes. In addition, he developed and conducted a training course on construction field observation and inspection of rockfall mitigation measures for WFL field staff.

Clearwater Junction Geotechnical Explorations, Swan Valley, Montana. MDT planned to realign portions of MT83 approximately 5 miles north of the intersection of MT83 and MT200, near Salmon Lake. Two areas were anticipated to require soil nail walls above rock outcrops. MDT asked LT to perform additional geotechnical borings in at least three locations above the roadway to confirm the soil and rock conditions present at the walls. Mr. Black was Project Manager responsible for a site reconnaissance, the

exploration program that included crane assisted borings and a test-cut, the development of the laboratory program, and providing a soil nail wall constructability review.

Ketchum-Challis SR 75 Rockfall Mitigation Design, Stanley, Idaho. Project Manager for a rockfall mitigation project for WFLHD for a ¾-mile section of Idaho State Route 75 that traverses the Sawtooth National Recreation Area near Stanley, Idaho. Work tasks included site investigation, geotechnical analysis, and development of rock mitigation options for 15 delineated rock slope areas within the project limits, interaction with stakeholders, and development of PS&Es. Slope stabilization and protection measures included scaling, rock bolting, draped and pinned mesh, and attenuator fences.

Banks-Lowman Highway Rockfall and Debris Flows, Banks, Idaho. The Banks-Lowman highway is in mountainous terrain with steep cutslopes on the inside of the roadway and steep fill slopes on the outside of the highway. Based on results of a Rockfall Hazard Rating System (RHRS) inventory, WFL identified 13 slopes along the 33.5-mile-long corridor that are the most hazardous. As Senior Engineering Geologist, Mr. Black provided rockfall mitigation designs for these various sites. Work tasks included detailed site reconnaissance, field explorations including difficult-access rope work, geotechnical analysis and computer modeling of slopes, design of rockfall mitigation measures, and preparation of PS&Es. Mitigation options included mesh, blasting, scaling, rock bolts, attenuators, rigid barriers, flexible rockfall barriers, and realignments.

Ohio Department of Transportation Landslide Inventory Development and Implementation, Columbus, Ohio. As Project Geologist, assisted in developing a statewide Landslide Hazard Rating Matrix (LHRM) as a tool to manage landslide hazards along Ohio DOT highways. The Ohio LHRM provides a relative ranking of sites for landslide hazard and vulnerability, which ODOT utilizes as a tool for prioritizing capital expenditures for mitigation. The system takes failure/movement classification and causation, geologic and groundwater conditions, roadway construction methods and material properties, impacts of failures on roadways and traffic, failure and maintenance frequency, annual maintenance data and costs, remediation concepts and estimated costs, and public safety into account and yields a unique numerical rating for each slope.

Rockfall Hazard Rating System Implementation, Statewide, Montana. Mr. Black was a member of the team that developed and implemented Montana's original the Rockfall Hazard Rating System (RHRS) to better manage rock slope assets along MDT highways. Mr. Black developed the conceptual rockfall mitigation designs and cost estimates for the 100 highest rated sites during the multi-year statewide implementation of MDT's Rockfall Hazard Rating System (RHRS).

Washington SR 12 Rockfall Mitigation, White Pass, Washington. As Senior Engineering Geologist, conducted geologic reconnaissance for rockfall hazards at three sites along SR 12. Performed detailed structural mapping of roughly 1200-feet of slopes ranging from 30-to 250-feet high. Assessed structural conditions and directed rockfall computer simulations and slope stability modeling. Developed mitigation alternatives and cost estimates for scaling, rock bolting, rock catchment barriers, draped mesh, and barriers.

US26 Mt. Hood Rockfall, Government Camp, Oregon. Senior Engineering Geologist for the design of rock cuts for a segment of US26 between MP 49.60 and MP 50.00. Provided preliminary and final design for the half-mile-long road segment that included cut slope and fallout area design recommendations, rockfall mitigation recommendations, and PS&E preparation. Cut slope recommendations included design options with cost comparisons, i.e. steeper cuts vs. more slope reinforcement (rock bolts). Other work tasks included review of exploration program, rock cores, and rock structure data collected by ODOT Region 1.

LAWRENCE A. PIERSON, STAFF CONSULTANT

Education

B.S. in Geology, University of California, Los Angeles, California

Registration

Certified Engineering Geologist – Oregon, Washington
Registered Geologist – Oregon, Washington

Boards and Societies

Chair, Committee on Engineering Geology, National Academy of Science, TRB
Member, Subcommittee on Rockfall Management, National Academy of Science, TRB
Member, Subcommittee on Geotechnical Asset Management, National Academy of Science, TRB
Member, Association of Engineering Geologists, Oregon Section
Member, International Society of Rock Mechanics
Member, The American Rock Mechanics Association

Professional Career

2000-present Landslide Technology, Portland, Oregon; Staff Consultant
1978-2000 Oregon Department of Transportation; Chief Engineering Geologist and Geotechnical Manager

Relevant Experience

Mr. Pierson is a nationally recognized expert in the field of rockfall mitigation with a specialty in transportation projects. He was ODOT's Chief Engineering Geologist responsible for rock slope and rockfall mitigation design for over 15 years. His work experience included rock slope design for new highway alignments as well as remedial design for existing rockfall problem areas. He developed several standard construction specifications, special provisions and inspection standards for blasting, rock bolting, shotcreting, and rock slope scaling.

Mr. Pierson has led several rockfall research projects with funding totaling over $900,000. Beginning in 1989, ODOT performed the national pooled-fund study entitled the Rockfall Hazard Rating System (RHRS). Mr. Pierson initiated the project and was the Principal Researcher. The RHRS provides a nationally and internationally recognized methodology for proactively managing rockfall hazards. Mr. Pierson developed the Rockfall Hazard Rating System training course and manual for the FHWA. He has taught the course to numerous state DOT's and in other countries.

More recently, as Principal Researcher, Mr. Pierson completed a five-year long, pooled-fund research effort to develop a state-of-the-art method for sizing fallout areas adjacent to highway rock cuts. The project, funded by several states and the FHWA, gathered extensive information about the behavior of rockfall on rock cut slopes and fallout areas commonly built adjacent to roadways. The results of the study have been published as a national guideline for rock fallout area design.

Mr. Pierson has authored numerous technical and research papers and articles on geotechnical issues and has authored or co-authored several publications. These have included the Oregon Soil and Rock Classification Manual, the Rockfall Hazard Rating System Implementation Manual and NHI Participant's Manual, the Rockfall Catchment Area Design Guide, and the TRB Special Report #247 titled, "Landslides, Investigation and Mitigation."

He has taught numerous classes on rockfall as an FHWA National Highway Institute instructor. He has been the Keynote Speaker at the national meeting of the Association of Engineering Geologists and has taught short courses on rock slope hazard assessment and rock slope engineering at two national meetings. He provides classes on rock blasting and has been the keynote speaker at the regional meeting of the International Society of Explosives Engineers. Representative project experience includes the following:

Rockfall Hazard Rating System Implementation, Statewide, Montana. Project Manager for the multi-year, statewide implementation of the Rockfall Hazard Rating System (RHRS) for the entire 10,000 miles of the state's highway system. Implementation included the design of a custom Microsoft Access database for the RHRS results, production of a digital photograph management system, the detailed examination of over 2,500 potential hazardous slopes, and development of preliminary designs and cost estimates for the top 100 rated sites in the state. Provided RHRS training to MDT geotechnical, maintenance, design and management personnel.

Going-to-the-Sun Road (GTSR), Rockfall Hazard Rating System Implementation, Glacier National Park, West Glacier, Montana. Senior Engineering Geologist responsible for implementing the Rockfall Hazard Rating System for the 50-mile-long GTSR in Montana and provided emergency repair recommendations for five storm-damaged road areas. Developed preliminary rockfall mitigation designs for the most hazardous rockfall sites and final designs for the top 25 sites in the park. Mitigations included slope scaling, rock bolting and the applications of sculpted shotcrete to match the existing natural rock. Polyurethane Resin (rock gluing) was included as a mitigation measure through final design. Provided technical review during construction and prepared an inspector training course for Western Federal Land Highway Division personnel.

MT 49 Looking Glass Hill Road Landslide and Rockfall Evaluation, East Glacier, Montana. Project Manager to develop landslide and rockfall mitigation recommendations of a seven-mile segment of MT 49 that had a long history of pavement settlement and distress associated with landslide movement. Conceptual mitigation options were developed for nine landslides and three rockfall hazard sites. The exploration program required 29 borings with inclinometer casing and vibrating wire piezometers that were monitored for one to two years.

Unstable Slope Management Program (USMP), Alaska, AKDOT&PF. Current Research Project Manager for the development and implementation of the statewide USMP system based on Asset Management principals. When completed, the USMP will include both hazard and risk assessments, condition surveys, service life predictions and condition indices for all unstable slopes throughout the AKDOT&PF highway system. As part of the agency's overall Transportation Asset Management initiative, the USMP will provide performance information used to guide Alaska's highway corridor investment strategies.

Badrock Canyon Rock Slope Monitoring and Instrumentation, Columbia Falls, Montana. Large tension cracks are present above a narrow section of US Hwy 2 in northwestern Montana and does not meet modern safety standards. In order to fully characterize the rock mechanics above the roadway and define possible slope stability issues, a crack monitoring program was initiated. As Project Manager, Mr. Pierson was responsible for overseeing the continuation of monitoring services and upgrading of site instrumentation. Electronic vibrating wire crackmeters (VWC) with dataloggers were installed. Additionally, a terrestrial LiDAR survey program was initiated to detect movement of the face at selected rock outcrop locations above the road.

Ketchum-Challis Rockfall Mitigation, Ketchum-Challis Highway, ID 75, Stanley, Idaho. Project Manager and Lead Designer for rockfall mitigation designs for 15 rockfall sites within a ¾-mile stretch of highway. Designs had to accommodate a compressed construction season and an adjacent high-use rafting river. Mitigation included rock bolting, cable lashing, anchored and draped mesh, and shotcrete.

Banks-Lowman Highway Rockslide, Idaho. Project Manager for the emergency response site evaluation and rockfall mitigation design for a 50,000 cubic yard rockfall event that destroyed existing rockfall protection measures. Supervised field reconnaissance of the nearly 300-foot high rock slope. Used computer rockfall simulations to develop cost-effective mitigation strategy to protect 500 feet of highway below the slope. Prepared recommendations to grade small portions of the slope to remove launch features, improve catchment ditch geometry, construct sacrificial MSE wall barrier, and flexible rockfall fences.

Rockfall Catchment Area Design Guide, Oregon Department of Transportation, Statewide, Oregon. Led the development of an FHWA design guide for sizing rock fallout areas adjacent to highways. Research included rolling over 12,000 rocks. Prepared the final report and User's Manual, which included design charts and sample applications in an electronic format. An implementation training course to be developed and taught at the five FHWA-sponsored Regional Geotechnical Conferences.

Statewide Implementation of the Rockfall Hazard Rating System, Utah Department of Transportation. Provided training to Department geotechnical, management, design, maintenance and research staff on the use of the RHRS. Served on the Technical Advisory Implementation Committee. Provided leadership and review of the modifications of the RHRS to meet Department conditions and needs, the development of the RHRS GIS-based database and Preliminary and Detailed Ratings.

Rockfall Hazard Rating System, Boise, Idaho. Instructed the 2-day National Highway Institute Course, Rockfall Hazard Rating System, to Idaho Transportation Department (ITD) Geotechnical, Design, and Maintenance staff.

I-15 Stickney to Hardy Creek Rockfall, Cascade, Montana. Mr. Pierson was Project Engineering Geologist and provided Senior-level review of a geotechnical evaluation of the rock slope near mile point 245.6 along I-15 which experienced a major rockfall event. Work tasks included gathering design information for different mitigation options including the anticipated design quantities and an evaluation of the constructability and hazard reduction for each option. Office analyses were performed to complete preliminary design of each option and a decision matrix for MDT's use in evaluating the options. A preliminary design report was prepared.

Weeksville West Project - Rock Cut and Reinforcement, Plains, Montana. Managed the technical support for rock bolt design and construction of 127 rock bolts and 50 rock dowels. Identified the rock bolt locations, lengths and orientations to stabilize rock blocks within five cut slopes up to 85 feet tall. Design decisions were made following each lift excavation so the installations could be made from the temporary excavation benches. Developed the rock bolt acceptance testing procedure and managed the full-time construction observation services provided to MDT.

South Tongass Highway Rockfall, Ketchikan, Alaska. Geotechnical Project Manager for a rapid response investigation into a major rockfall event on a city highway. Performed geologic mapping of rock structure, evaluated rock slope stability, and provided recommendations for stabilization measures including scaling, rock bolts and barrier fences.

BENJAMIN A. GEORGE, ASSOCIATE ENGINEER

Education

M.S. in Geological Engineering, Colorado School of Mines, Golden, Colorado
B.S. in Geology and Geological Engineering, Colorado School of Mines, Golden, Colorado

Registration

Civil Engineer – Oregon, Washington, Alaska, Montana
Certified Engineering Geologist – Oregon
Registered Geologist – Oregon, Wyoming
Level 1 Technician – SPRAT (Society of Professional Rope Access Technicians)

Societies

Member, Association of Engineering and Environmental Geologists, Oregon Section

Professional Career

2010-present	Landslide Technology, Portland, Oregon; Associate Engineer
2008-2009	URS Corporation, Denver, Colorado; Project Geological Engineer
2004-2007	Landslide Technology, Portland, Oregon, Staff Engineer

Relevant Experience

Mr. George has over 12 years of geotechnical engineering and engineering geology experience in the Pacific Northwest and Mountain West. His work experience has included evaluation of rock slope hazards, development and design of rockfall and rock slide mitigation measures, rock slope cut design, investigation of landslides, and design of slide repairs and drainage systems. Representative projects include the following:

I-90 MP 22 Emergency Response Rockfall Evaluation, DeBorgia, Montana. Project Engineer responsible for providing on-slope rockfall evaluations via rope access techniques of a rock slide that occurred near mile post MP 22.5 along Interstate-90 west of St. Regis, Montana. Coordinated with MDT geotechnical personnel to evaluate the slope conditions, develop and design conceptual rockfall mitigation options and observe construction of MDT selected mitigation measures via rope access techniques. Oversaw kinematic analysis and rockfall simulation modeling of the slope.

I-15 Rockfall Mitigation, Helena to Great Falls, Montana. Project Engineer responsible for assessing rockfall hazards associated with 15 sites along Interstate-15 between Sieben Ranch and Hardy Creek Hill, Montana in coordination with MDT geotechnical personnel. Rock slopes were evaluated and geologic mapping conducted on-slope via rope access techniques and from the road level via boom-lift equipment. Directed analyses of the rock slopes including kinematic analyses, rockfall simulation modeling and slope stability modeling. Prepared conceptual level rockfall mitigation designs for all 15 sites including scaling, rock bolting, trim blasting, flexible rockfall barriers, rockfall attenuator fences, draped mesh, ditch catchment improvements and concrete roadside barriers. Prepared contract plans, specifications and engineer's estimates for nine of the sites in coordinate with MDT personnel.

US 93 Rockfall Construction Assistance, Lakeside, Montana. Project Engineer responsible for assisting MDT personnel with rockfall mitigation and installation of monitoring instrumentation along US 93 south of

Lakeside. Work tasks included observation of rock scaling; guiding and documenting rock bolt installation and acceptance testing; determining additional rock bolt and rock dowel locations, bar lengths and orientations; and assisting with the installation of monitoring instrumentation. 32 rock bolts, 10 rock dowels, 7 tilt plates, and 6 extensometers were installed.

I-90 MP 24 and 6.5 Rockfall Mitigation Construction Assistance, Drexel, Montana. Project Engineer responsible for assisting MDT with observation and technical guidance for installation of rockfall mitigation measures at mile points (MP) 24.1 and 24.6 along Interstate-90 west of St. Regis, Montana. Conducted on-slope observations via rope access techniques to assess slope conditions and observe construction of mitigation measures. Provided technical guidance to MDT and the contractor during the rock scaling activities, installation of a rockfall attenuator fence and construction of ditch catchment area improvements. Provided an emergency response evaluation of rockfall hazards associated with rock slide that occurred at a third site (MP 6.5). Developed conceptual rockfall mitigation measures for stabilizing the slope and improve catchment capabilities of the roadside ditch.

US 2 Rockfall Mitigation, Libby, Montana. Project Engineer responsible for coordination with MDT and AIS Construction personnel to complete rockfall mitigation of a 300 foot tall wedge failure along US 2 west of Libby. Work tasks included directing rock scaling efforts; locating and verifying acceptance testing of 58 rock bolts and 10 rock dowels; designating approximately 1500 square feet of shotcrete areas; layout of 400 square feet of draped netting including 4 cable anchors; and aligning 250 feet of 184 ft-ton rock catch-fence including 11 posts and tie-back anchor locations.

Going-to-the-Sun-Road – Phase 1 Geotechnical Services, Columbia Falls, Montana. Project Engineer responsible for assisting in the implementation of the Rockfall Hazard Rating System (RHRS) on a portion of the western side of the Going-to-the-Sun-Road (GTSR) in Glacier National Park. Assisted with field locating blocks for rock bolting and areas requiring scaling. Performed field reconnaissance and geologic investigation of potential material sources for reconstruction of a guardwall along GTSR. Responsible for coordination of guardwall repair testing program.

I-84 MP 61.2 Rockfall Mitigation, Hood River, Oregon. Project Engineer responsible for assisting the Oregon DOT with mitigating a rock slide area on a 250-foot long, 160-foot tall rock slope adjacent to Interstate-84 east of Hood River, Oregon. Planned and conducted an on-slope geologic reconnaissance of the rock face to collect geologic orientations and evaluate rockfall and rock slide hazards. Developed conceptual mitigation options and cost estimates. Directed analysis of the rock slope including kinematic analyses, rockfall simulation modeling and rock slide evaluation. Developed contract plans, specifications, and an engineer's estimate (PS&E) for construction of a 100-foot excavation, installation of approximately 600 linear feet of rock dowels and approximately 1,300 linear feet of horizontal drains. Coordinated with ODOT personnel to develop designs, acquire a national scenic area permit, and the PS&E.

US 26 Mt. Hood Highway Safety Improvements, Government Camp, Oregon. Project Engineer responsible for the review of designs developed by ODOT for 100-foot plus rock cut slopes along US 26 between Zig Zag and Government Camp, Oregon. Conducted kinematic analyses and rockfall simulation modeling to assess slope conditions of the existing and proposed cut slopes. Provided design recommendations for new rock cut slopes for an approximate half mile segment of the project. Performed a geologic reconnaissance, conducted kinematic analyses and modeled rockfall simulations. Coordinated with ODOT personnel to develop plans, specifications and an engineer's estimate. Assisted ODOT during bidding of the project and with construction of the new cut slopes and rockfall mitigation measures.

Paul D. Thompson
Management Systems • Engineering Economics
17035 NE 28th Place, Bellevue, WA 98008
425-224-5443; pdt@pdth.com

Paul D. Thompson is an internationally recognized expert in management systems and engineering economics, including research, design, and development of analytical processes for managing transportation assets. Mr. Thompson is one of the world's leading authorities on life-cycle planning, risk analysis, and optimization of infrastructure investments. He has served as a consultant in this area to transportation agencies at the local, state, and national levels worldwide for 34 years, has authored many of the major AASHTO and international guidebooks on asset management implementation, and has contributed to numerous state Transportation Asset Management Plans.

He has been Manager and principal architect of the multi-contract implementation program for Pontis, a management system for bridges. Pontis was the most successful transportation software joint development project ever undertaken, eventually receiving the support of 46 states. He has provided customization and implementation support services in connection with Pontis to more than half of the states and several other countries, and has continued his work for AASHTO in architectural design and project management for the next generation of bridge load rating and design software, Virtis and Opis. He has designed and/or managed development of more than a dozen other bridge management systems worldwide. He developed the analytical architecture and design for AASHTOWare Bridge Management (formerly Pontis) release 5.2, which will include a number of new innovations in multi-objective optimization and the modeling of deterioration, costs, and risk.

Mr. Thompson continues to advance the state-of-the-art in asset management and bridge management systems. In NCHRP Project 08-71 (published as Report 713), he authored a guidebook on methods to estimate the life expectancies of all types of highway assets. In NCHRP Project 12-67 (published as Report 590), he developed a multi-objective optimization framework for network level and bridge level decision support. For Florida DOT he developed a new user cost model for bridge functional deficiencies, a new methodology for classifying and estimating bridge maintenance, repair, and rehabilitation (MR&R) costs, a new methodology for risk analysis featuring a scientific approach to quantifying natural and man-made hazards, and a new method for developing deterioration models. These projects included design and development of digital dashboards to assist engineers with project level and network level decision support.

For Alaska Department of Transportation and Public Facilities, Mr. Thompson has prepared a Synthesis and Work Plan for Asset Management Implementation, which addresses all of the infrastructure assets owned by the department, including roads, bridges, airports, ferries, buildings, and equipment. In projects for Alaska, Colorado, and NCHRP 24-35, he has helped develop the framework for the new field of geotechnical asset management, addressing roadway embankments, unstable slopes, retaining walls, material sites, and rockfall protection systems. This framework addresses techniques for managing assets subject to seismic risk, landslide, permafrost melting, and other natural and man-made hazards.

Other management system efforts which Mr. Thompson has directed include pavement management systems, transit facility management systems, capital needs inventories, project tracking systems, transportation and land-use planning, financial analysis systems, and marketing research analysis tools. Many of these projects have included significant improvements in the state-of-the-art by developing new optimization techniques or incorporating analytical techniques into user-friendly computer environments.

Asset Management	Consultant, Transportation Asset Management Plans for Minnesota, Nevada, Ohio, Texas, Louisiana Consultant, Alaska Geotechnical Asset Management Plan – retaining walls, slopes, material sites. Co-author, NCHRP 24-35, Asset Management for Flexible Rockfall Protection Systems Author, Alaska DOT&PF Asset Management Synthesis and Work Plan Consultant, Washington State audit review of infrastructure needs analysis process Co-author, NCHRP 08-69, Asset Management Volume 2: Focus on Implementation Co-author, NCHRP 20-24(11), Asset Management Guidelines for Transportation Agencies

Consultant, Retaining wall asset management plan for Colorado DOT
Final report author, FHWA Management System Integration Committee
Consultant, NCHRP 20-74A, Service Levels for the Interstate Highway System
Consultant, NCHRP 20-74, Asset Management Plan for the Interstate Highway System
Co-author, NCHRP 08-71, Life Expectancies of Highway Assets
Developer, Colorado DOT inspection system for sign, signal, and high-mast light pole structures
Technical consultant, Asset Management Guidelines, Transport Association of Canada
Consultant, FHWA Peer review panels for NBIAS, HERS, and TERM, systems for national infrastructure needs analysis for the US Congress
Technical consultant, NCHRP 20-64 - TransXML
Co-author, NCHRP 363, Role of Highway Maintenance in Integrated Management Systems
Project manager, Finland integrated bridge, pavement, and maintenance management systems
Technical consultant, statewide asset management framework for Michigan
Technical consultant, Michigan integrated management systems (9 systems)
Technical consultant, Delaware integrated management systems (7 systems)
Technical consultant, Puerto Rico integrated management systems (7 systems)
Technical consultant, Nova Scotia management systems (bridge, pavement, safety and traffic)
Project manager, Boston Metropolitan District Commission integrated management systems (pavement, bridge, traffic signals, and street lighting)
Technical consultant, asset costing and performance measures for New Jersey Transit Corporation and Massachusetts Bay Transportation Authority

BMS Experience

Bridge Management Systems (BMS) – new development

Project management, design, and modeling for NBIAS, FHWA's national-scale adaptation of the Pontis network-level models for US Congressional budgeting
Needs analysis, British Columbia Bridge Management System
Updating of the NCHRP Report 483 Bridge Life Cycle Cost Analysis model for FHWA
Project management, design and development of the Pontis Bridge Management System for AASHTO and the US Federal Highway Administration
Design of the Minnesota DOT Risk-Based Planning System for Bridges and Structures
Development of bridge deterioration and action effectiveness models for Virginia DOT
Co-project management and design of the Ontario Bridge Management System
Design of the Québec bridge management system
Technical consultant for the Triborough Bridge & Tunnel Authority (NY) Bridge Management System
Project management, design, and development of integrated facility project evaluation tools (including bridge management) for the New Jersey Transit Corporation
Design of the Massachusetts Bay Transportation Authority (Boston) Bridge Management System
Technical consultant for the Switzerland Bridge Management System
Technical consultant for the Sweden Bridge Management System
Technical and management consultant for the Ohio Bridge Management System

Bridge Management Systems –Customization and training

Peer reviewer, FHWA Bridge Management Information Systems Laboratory
Technical consultant, Pontis models for Alabama's Bridge Information Management System
Design of a Pontis migration strategy for Alabama DOT
Customization of the Florida Project Level Analysis Tool for Maine DOT
Assistance with bridge management system implementation for Manitoba Infrastructure & Transp
Development of Pontis implementation plan for New Jersey DOT
Project management, design, and development of customized versions of Pontis 2.0 for the states of Oregon, Colorado, Louisiana, Tennessee, and Minnesota
FHWA-sponsored Pontis workshops for the states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, District of Columbia, Virginia, Georgia, Florida, Tennessee, Ohio, Indiana, Illinois, Michigan, Louisiana, Arkansas, Missouri, Iowa, Minnesota, Nebraska, Kansas, Oklahoma, Texas, Colorado, Wyoming, Montana, Idaho, Utah, Arizona, California, Oregon, Washington, and Hawaii

Locally-sponsored Pontis workshops and training courses for Rhode Island, Illinois, Ohio, Puerto Rico, Switzerland, Hungary, United Kingdom, Spain, Australia, Kuwait
Course designer and lead instructor for NHI Bridge Management Training Courses for South Carolina, Arizona, Washington, Louisiana, Oklahoma, Florida, Texas, Tennessee, and Michigan
Technical support of Pontis implementation for the City of Denver and the States of Maine, Florida, Tennessee, Ohio, Illinois, Michigan, Louisiana, Iowa, and Colorado
Technical support of Stantec Bridge Management System implementation for the Provinces of Ontario, British Columbia, Saskatchewan, Québec, and Nova Scotia and the City of Hamilton, Ontario

Bridge Management Systems – Research

Consultant, Bridge deterioration models for Massachusetts Bay Transportation Authority
Advisory Panelist and Technical Consultant, FHWA Long Term Bridge Performance Program
Consultant, Pennsylvania DOT Risk Management Strategy
Expert Peer reviewer, FHWA Bridge Management Information Systems Laboratory
Consultant, NCHRP 14-15, Development of a national maintenance database for bridges
Co-principal investigator, NCHRP 12-67, Multi-Objective Optimization for BMS
Principal investigator, development of user cost models for Florida DOT Pontis implementation
Co-principal investigator, updating of AASHTOWare Bridge Management models for Florida DOT
Co-principal investigator, development of structure risk models for Florida DOT
Co-principal investigator, development of Pontis deterioration and cost models for Florida DOT
Co-principal investigator, development of project-level bridge management models for Florida DOT
Co-principal investigator, development of program management decision support for Florida DOT
Co-author, AASHTO Guidelines for Bridge Management Systems
Co-author, NCHRP Synthesis 227, Collecting and Managing Cost Data for BMS
Consultant, NCHRP 20-07, Bridge Performance Measures
Consultant, NCHRP 12-50, Bridge Software Validation Guidelines and Examples
Consultant, NCHRP 12-51, Effect of Truck Weight on Bridge Network Costs

Other bridge-related software

Software design services and member of the contractor management team for Virtis, the new AASHTO Bridge Load Rating System, and Opis, the new AASHTO Bridge Design System
Task Manager, integration of AASHTO's BRIDGEWare bridge software suite (Pontis, Virtis, Opis)

Committees

TRB Expert Technical Group on Bridge Durability and Preservation (Long-Term Bridge)
Transportation Research Board Committee on Asset Management
Transportation Research Board Committee on Bridge Management
Chair, Transportation Research Board Subcommittee on Bridge Life Cycle Cost Analysis
Transportation Research Board Committee on Bridge Maintenance
SHRP2 Reliability Technical Expert Task Group on Statistics, Models and Methods
Editorial Board, American Society of Civil Engineers Journal of Bridge Engineering
Editorial Board, Structures and Infrastructure Engineering Journal
FHWA Expert Technical Group on Bridge Costing
FHWA Management System Integration Committee
International Association for Bridge Maintenance and Safety, Bridge Management Committee

Education

C.S.S., Administration and Management, Harvard University Extension (1987)
M.S., Transportation, Massachusetts Institute of Technology (1982)
B.S., Civil Engineering, University of Washington (1980)

Formerly

Principal, Cambridge Systematics, Inc.
Research Assistant, Massachusetts Institute of Technology
Planning and Finance Depts., Tri-County Metropolitan Transportation District of Oregon
Assistant Surveyor, City of Longview, Washington

More info

For further information and a selection of useful reports, see www.pdth.com.

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SUMMARY

David Stanley has had a lengthy career as an engineering technician, geotechnical exploration driller, engineering geologist, and attorney. Mr. Stanley has about 30 years' experience in geotechnical work culminating in his position as the Chief Engineering Geologist and Geotechnical Services Manager for the Alaska Department of Transportation & Public Facilities. Dave's start in the early 1970s allows him a long-term look at how transportation agencies perform and evolve over time. Mr. Stanley's decade of law school and legal practice mid-way through his geotechnical career and his exposure to transportation issues at a national level combined with his many years as an engineering geologist provide him with a unique perspective and tool set for addressing modern transportation issues.

GEOTECHNICAL EXPERIENCE

Chief Engineering Geologist and Geotechnical Services Manager, State of Alaska Department of Transportation & Public Facilities (AKDOT), Anchorage, Alaska. 2000-2014. Led agency's Geotechnical Services headquarters section, providing standards and policy guidance and technical support for the agency headquarters group and for each of the three AKDOT Regions. Directed the headquarters Materials Geotechnical Section that included the engineering geology, exploratory drilling and foundation design programs. Created policies and standards and delivered them to staff statewide, authored AKDOT Geotechnical Procedures Manual, reviewed work of geotechnical staff statewide, provide technical support for regional project geotechnical issues. Developed research concepts and projects for geotechnical issues including engineering and engineering geology functions and transportation asset management. Managed research work conducted by staff and managed a multi-faceted research and development program conducted by consultant contractors. Provided technical expertise in specialty areas including rockfall mitigation, rock slope design and geotechnical exploration for structural foundations. From 2009-14, focused on pioneering research for development of Geotechnical Asset Management (GAM) principles and programs for AKDOT assets including unstable slopes, embankments, materials sites and earth retaining structures.

Engineering Geologist, AKDOT, Anchorage, AK. 1996-2000.

Geotechnical Manager, engineering firms, Anchorage, AK. 1983-86.

Soils Exploration Manager, drilling contractor, Anchorage, AK. 1982-83.

Engineering Geologist, AKDOT, Anchorage, AK. 1979-1982.

Engineering Technician, Soils Laboratory Supervisor, **and** ***Driller***, various state and private sector employers in Anchorage and Fairbanks, AK. 1970-79.

GEOTECHNICAL PUBLICATIONS

1980 "Failure mechanisms of the Drift Creek Slide," Thrall, G.F., Jack, R., Johnson, J.J., and Stanley, D.A., Geological Society of America, Abstracts with Programs, v. 12, no. 3, p. 156.

GEOTECHNICAL ASSET MANAGEMENT RESEARCH & DEVELOPMENT

Developed and managed multi-million dollar research projects to develop first-of-its-kind geotechnical asset management plan and asset-specific GAM programs, including:

- Pioneered Geotechnical Asset Management concepts.
- Conceptualized and initiated a strategic research plan for researching, developing and implementing a GAM program at AKDOT.
- Advocated for and received significant funding through federal highway funding mechanisms,
- Collaborated with University of Alaska research programs to provide expertise and funding for research and development projects and funding,
- Recognized by AKDOT management as the "GAM Champion", and in that role, made numerous presentations to inform and train agency staff from Planning, Design, Construction, Maintenance & Operations and management of AKDOT.
- Advocated for GAM development and implementation both inside AKDOT and nationally through Transportation Research Board activities and networking with FHWA and state departments of transportation staff by participation in annual FHWA/State transportation agency-sponsored Northwest Geotechnical Workshops.
- Developed and executed contracts with asset management and geotechnical consultants to conduct research programs for GAM concepts and principles and for asset-specific programs for unstable slopes, material sites and earth retaining structures.
- Managed or participated as co-principal investigator in several GAM research projects.
- Recruited a diverse group of technical advisors for each project from FHWA local offices, FHWA Resource Center and FHWA Western Federal Lands staff; Washington and Colorado DOTs; a TAM consultant, geotechnical consultants, rockfall and slope stability consultants, and University researchers.

GEOTECHNICAL ASSET MANAGEMENT PUBLICATIONS

2011 "Geotechnical Asset Management Performance Measures for an Unstable Slope Management Program," Stanley, D.A. and Pierson, L.A., Proceedings 62nd Highway Geology Symposium.

2011 "Asset Management in a World of Dirt," Stanley, D.A., TR News, Vol. 277 Transportation Research Board – National Research Council, Washington, D.C.: 18-22.

2012 "Performance Measures for Rock Slopes and Appurtenances," Stanley, D.A. and Pierson, L.A., *in* Eberhardt, E., Froese, C., Turner, A.K. and Leroueil, S., eds., in Landslides and Engineered Slopes: Protecting Society through Improved Understanding, Proceedings of the 11th International and 2nd North American Symposium on Landslides and Engineered Slopes, Vol. 2, Banff, Alberta, Canada: 1113-1118.

2013 "Geotechnical Asset Management of Slopes: Condition Indices and Performance Measures," Stanley, D.A. and Pierson, L.A., *in* proceedings: GeoCongress 2013: Stability and Performance of Slopes and Embankments III, American Society of Civil Engineers.

2014 "Commentary: Geotechnical Assets - Build and Forget or Manage for the Future?" D.A. Stanley, Geo-Strata, March/April 2014, American Society of Civil Engineers.

2014 "Managing GAM Assets to Improve Performance," Anderson, Scott, A., Stanley, D.A. and Loehr, J. Erik, Geo-Strata, March/April 2014, American Society of Civil Engineers.

GEOTECHNICAL ASSET MANAGEMENT PRESENTATIONS

2010 "Asset Management in a World of Dirt," Stanley, D.A. organizer and moderator, Highway Geology Symposium – TRB Midyear Meeting, August 2010, Oklahoma City, OK

2010 "Mechanically Stabilized Earth Wall Corrosion in Nevada – A Case Study in Geotechnical Asset Management," John Thornley, Raj Siddharthan and David Stanley, Highway Geology Symposium – TRB Midyear Meeting, August 2010, Oklahoma City, OK

2010 "Geotechnical Asset Management," D.A. Stanley, Northwest Geotechnical Workshop (FHWA), October 2010, Lakewood, CO.

2011 "Material Site Inventory Project in Alaska and Its Implications for Asset Management and Planning for the Future," Hardcastle, Pete and Stanley, D.A., Geotechnical Asset Management presentation to TRB Committee AFP70 -Workshop on Aggregate Source Depletion and Future Supply, January 2011, Washington, D.C.

2011 "Performance Management & Performance Measures for Unstable Slopes," Stanley, D.A. and Pierson, L.A., Highway Geology Symposium, July 2011, Lexington, KY

2011 "Performance Management & Performance Measures for Unstable Slopes," D.A. Stanley, Northwest Geotechnical Workshop (FHWA), August 2011, Medora, North Dakota

2011 "Geotechnical Asset Management and Performance Measures," Stanley, D.A. and Pierson, L.A., Annual Meeting - National Association or Environmental and Engineering Geologists, September 2011, Anchorage, AK

2012 "Incorporating Geotechnical Assets into Transportation Asset Management," 9th International Transportation Asset Management Conference, April 2012, San Diego, CA

2012 "Performance Measures for Rock Slopes and Appurtenances," Stanley, D.A. and Pierson, L.A., June 2012, 11th International and 2nd North American Symposium on Landslides, Banff, Alberta, Canada

2012 "Transportation Asset Management & Performance Management for Parks Highway Corridor," Geotechnical aspects of corridor management for AKDOT, D.A. Stanley, July 2012, Anchorage, AK

2013 "Geotechnical Asset Management of Slopes: Condition Indices and Performance Measures," Stanley, D.A. and Pierson, L.A., GeoCongress 2013: Stability and Performance of Slopes and Embankments III, American Society of Civil Engineers, March 2013, San Diego, CA

2013 "Asset Management for Geotechnical Staff a.k.a.*"Asset Management in a World of Dirt",* AKDOT, April 2013, Anchorage, AK,

2013 "Geotechnical Asset Management for Design & Construction" AKDOT for Northern Region staff, Fairbanks, AK, March 2013

2013 "Geotechnical Asset Management Webinar," May-June 2013, sponsored by FHWA and AASHTO

COMMITTEE/ADVISORY BOARD ASSIGNMENTS/MEMBERSHIPS (past and present)

- Chief Technical Advisor and Subject Matter Expert for Geotechnical Research - AKDOT&PF
- Transportation Research Board (Active)
  - Chairman - Geotechnical Asset Management Joint Section Subcommittee – AFP00 and AFS00
  - Member - Engineering Geology Committee - AFP10
  - Member - Rockfall Sub-Committee - AFP10(1)
  - Member – Committee on Soil and Rock Instrumentation – AFS20
- National Cooperative Highway Research Program - Chairman of NCHRP 24-35 Panel – *Guidelines for Certification and Management of Flexible Rockfall Protection Systems.*

- Alaska DOT&PF Transportation Asset Management Implementation
  - Member - Original TAM Development Team (adviser to TAM Steering Committee)
  - Member - TAM Highways Team
  - Chairman - TAM Geotechnical Subteam
- Alaska DOT&PF Research Technical Advisory Committee Member or Sponsor:
  - Evaluation of In-Place MEMS Inclinometer Strings in Cold Regions
  - Measurement of Temperature and Soil Properties for Finite Element Model Verification
  - Pile Driving Analysis
  - Shallow Anchors and Anchored Mesh System for Cut Slope Protection in Ice-Rich Soils
  - Seismic Performance of Bridge Foundations in Liquefied Soils
- Alaska Geologic Mapping Advisory Board Chairman – AK Department of Natural Resources - Division of Geology & Geophysical Surveys
- Technical Advisory Committee - Pooled Fund, *Rockfall Catchment Area Design Guide.*
- Technical Advisory Committee - Pooled Fund, *Analysis & Design of Wire Mesh/Cable Net Slope Protection.*

EDUCATION

***Geology*,** Bachelor of Science, Oregon State University, 1979.
Engineering Management, Graduate Studies, University of Alaska, 1980-1982.
Law, Juris Doctor, University of Oregon School of Law. 1989.

GEOTECHNICAL LICENSES/CERTIFICATIONS

Licensed Geologist - Alaska (1984)
Certified Professional Geologist - American Institute of Professional Geologists (1984)
Licensed Geologist and Licensed Engineering Geologist - Washington (2002)
Certified Drilled Shaft Inspector - Oregon (2009)

LEGAL EXPERIENCE

1986-87 Law Clerk – Michael M. Bruce, Esq. Eugene, Oregon
1987-89 Law Clerk – Gleaves Swearingen Larsen & Potter. Eugene, Oregon
1989-96 Associate Attorney – Gleaves Swearingen Larsen Potter Scott & Smith. Eugene, Oregon. Practiced environmental, real estate and construction claims litigation and transactional law for private firm.

LEGAL WRITING

1989 "Oregon's Vested Rights Rule: A Statutory Solution to a Troublesome Problem," D.A. Stanley, Oregon Law Review Vol. 68, No. 4, University of Oregon, School of Law.

AWARDS

Northwest Geotechnical Workshop (FHWA)
"Hats Off" Award
"Mr. Northwest Geotech" Award
Federal Highway Administration
"Geotechnical Asset Management - FHWA Administrator's Team Award", 2013

GCS

JOHN WATERMAN, PMP, GISP

VICE PRESIDENT OF GEOSPATIAL SOLUTIONS

Highlights

GIS developer and manager with project management skills

Extensive International Experience

Certified PMP, GISP

Esri technical certifications

Esri ArcGIS Server Code Challenge winner, 2008

Years of Experience: 13

Education

Master of Science in Forestry – University of Montana

Bachelor of Science in Forest Management – Oregon State University

Mr. Waterman joined GCS in 2004. As Project Manager or Technical Lead, his main focus is driving customer projects to successful completion. Mr. Waterman oversees the companies GIS development projects, professional development and training for team members, and drive to explore and expand into new technologies, such as mobile and cloud GIS offerings.

ACCOMPLISHMENTS

Mr. Waterman's Project Management Professional (PMP) and Geographic Information Systems Professional (GISP) certifications demonstrate his wealth of experience, education and competency to lead and direct geospatial technology projects to successful completion.

TECHNICAL CAPABILITIES

Mr. Waterman technical skills primarily focus on the Esri technology stack. Mr. Waterman started his GIS developer career working with early Esri server technologies and the first builds of ArcGIS Desktop with ArcObjects while at Esri in Redlands, California. Mr. Waterman built the first ever Android mobile App utilizing ArcGIS Server technology to be deployed in the Google Play Marketplace. Most recently, Mr. Waterman has been focused on implementations in the various offerings for GIS in the cloud.

AWARDS

- 2008 Esri ArcGIS Server Code Challenge – First Place
- 2007 Esri ArcGIS Server Code Challenge – Honorable Mention

WORK HISTORY

Mr. Waterman brought a wealth of expertise and experience to GCS. He has worked for Esri's Implementations Services in Redlands, California and the Esri Denver office, where he provided consulting and technical services to clients working with desktop and server technologies. In addition, Mr. Waterman served as an ArcSDE database administrator and ArcObjects programmer for an Enhanced 911 software company, microDATA GIS Inc. Most recently at GCS, Mr. Waterman completed a project for the International Atomic Energy Agency (IAEA, a division of the United Nations), where GCS, within a highly restricted environment, implemented a custom geospatial SOA solution which integrated COTS GIS and imagery exploitation software, custom security software, and multiple data repositories/services to create one enterprise solution for over 400 users.

JOHN WATERMAN, PMP, GISP

WORK HISTORY

EMPLOYER	POSITION/TITLE	DATES
GCS	Vice President, Geospatial Solutions	2004-present
microDATA GIS Inc.	Senior GIS Program mer and Spatial Database Administrator	2004-2006
Esri	Consultant	2000-2004

TRAINING/CERTIFICATIONS

- 2012 Esri Technical Certification Enterprise Administration Associate
- 2011 PMP - Project Management Professional
- 2011 GISP - Geographic Information Systems (GIS) Professional
- 2010 Esri Technical Certification Web Developer Associate

CHRISTOPHER I. CARPENTER, ASSOCIATE ENGINEER

Education

M.S. in Geotechnical Engineering, University of California, Berkeley, California
B.S. in Civil Engineering, Oregon State University, Corvallis, Oregon

Registration

Civil Engineer – Oregon, Washington, California

Societies

Member and Past-Chair, American Society of Civil Engineers, Oregon Section Geotechnical Group

Professional Career

2002-present Landslide Technology, Portland, Oregon; Associate Engineer

Relevant Experience

Mr. Carpenter has over 14 years of geotechnical engineering experience in the western United States. He has extensive experience in rockfall hazard evaluations and slope stability analyses. Representative projects include the following:

Rockfall Hazard Rating System Implementation, Statewide, Montana. Project Engineer responsible for assisting with field investigations for the multi-year, statewide implementation of the Rockfall Hazard Rating System (RHR S). Conducted slope screening preliminary surveys and detailed RHRS surveys of over 1,500 road cuts throughout Montana. Maintained a portion of the Microsoft Access database for the preliminary and detailed rating phases of the hazard rating system. The database incorporated crucial features, such as digital photograph management and detailed rating score calculations, to economize the field effort. Geographic Information System (GIS) maps and data products were developed for utilization by the state for prioritizing mitigation efforts.

Looking Glass Hill Geotechnical Investigations, East Glacier, Montana. Project Engineer responsible for performing geotechnical investigations for a series of eight sections of rural highway impacted by large ancient landslides. Work tasks included developing stability analyses, mitigation options and cost estimates for each landslide area. Coordinated with MDT geotechnical personnel in developing mitigation measures to determine feasibility at remote locations with relative impact to the surrounding environment and consideration of design preferences. Developed a decision matrix for MDT to use in the evaluation of mitigation measures and cost estimates for the landslides at the project site.

Weeksville West Project - Rock Cut and Reinforcement, State Route 200, Plains, Montana. As part of a construction project to realign and improve a 4-mile long section of Montana State Highway 200, west of Plains, Montana, the realignment and enlargement of existing rockfall catchment areas required five major rock cuts. Four of the cuts were designed to be cut at 0.25H:1V and the fifth at a 0.5H:1V slope angles. However, the five slopes required rock bolt and rock dowel reinforcements to perform adequately. MDT retained Landslide Technology to provide technical support for the slope reinforcements. As Project Engineer, Mr. Carpenter was responsible for identifying the bolt and dowel locations, bar lengths and orientations, and guiding and documenting rock bolt installation and acceptance testing.

Pioneer Mountain to Eddyville Landslides, US Route 20 Realignment, Newport, Oregon. Geotechnical Engineer responsible for characterizing and developing mitigation measures for multiple, large landslides impacting a highway realignment. Supervised large exploration and instrumentation program utilizing several contractors with special, limited-access drills. Developed plans and specifications for two large mitigation contracts. Mitigations utilized horizontal drains, trench and finger-drains, ground anchors, mechanically stabilized earth fills, key trenches, and toe buttresses. Developed and executed test program of full-scale test ground anchors to measure the long-term creep behavior of low-quality, siltstone bedrock.

Libby Rockfall Construction, Libby, Montana. Mr. Carpenter served as Project Engineer for a portion of the rockfall mitigation of a 300-foot tall wedge failure along US 2 west of Libby. Work tasks included directing rock scaling efforts, and locating and verifying acceptance testing of rock bolts and dowels.

Going-to-the-Sun Road (GTSR) – Embankments and Guardwalls, Columbia Falls, Montana. As Project Engineer, conducted detailed Rockfall Hazard Rating System (RHRS) surveys on sites along the western mountainous portion of the Going-to-the-Sun Road (GTSR) in Glacier National Park. Assisted in the production of a Microsoft Access database detailing each site. Researched and compiled information on remedial techniques for the rehabilitation of the guardwalls along GTSR. Compared the effects of various mitigation options on slope load, drainage, environmental impact, traffic impact, and design life.

US 93 Rockfall Construction Assistance, Lakeside, Montana. Project Engineer responsible for observing rockfall mitigation along US 93 south of Lakeside. Work tasks included observation of rock scaling, and guiding and documenting rock bolt installation and acceptance testing.

Scoby Hill Road Landslide, Springville, New York. Mr. Carpenter was Project Engineer for landslide stabilization studies for a roadway realignment that reactivated and ancient landslides during placement of roadway embankment fill. Work tasks included performing stability analyses and developing mitigation options to reduce deformation during construction and provide long-term stability to the highway. Mitigation measures included embankment removal, slope regarding, horizontal drains, and rockfill buttresses.

Greens Creek Mine Access Road Distress, Admiralty Island, Alaska. Project Engineer responsible for providing construction observation of emergency repairs to the Kennecott Greens Creek Mine access road. A Mechanically Stabilized Earth (MSE) wall was placed at MP 5.45 in an area that had developed a depression and headscarp crack, and significant slumping on the outer slope of the road embankment. Repair required field fit of engineering solution to match the conditions encountered during construction. Design was modified in the field to account for the presence of organic material and sidecast fill beneath the existing roadway.

South Santiam Highway Landslides, Sweet Home, Oregon. Project Engineer for the investigation of 6 large landslides causing distress to Highway 20 through the Cascade Range. Distress to the highway has caused on-going maintenance demands and concern about highway safety for ODOT. Assisted with conceptual analyses, mitigation options, and cost estimates for slide repairs. Mitigation options evaluated included fill removal, soldier pile-tieback wall, shear key, lightweight fill, highway realignment, deep patch, and dewatering methods (including trench drains, horizontal drains, and improved surface water collection).

Lemolo 2 Canal Slides, Toketee Falls, Oregon. Project Engineer for the emergency response related to two slides that impacted PacifiCorp's Lemolo 2 Canal. Tasks included a site reconnaissance and observations of the canal, canal road, ground cracks, and sinkhole to assess the immediate landslide hazards. Assisted with field explorations which included drilling five borings. Several conceptual treatment options were considered for long-term treatment of the slides including a tied-back soldier pile wall, a rockfill buttress, unloading the head of the slide, and continued monitoring only.

ADAM D. KOSLOFSKY, PROJECT GEOLOGIST

Education

B.S. in Geology, Oregon State University, Corvallis, Oregon

Registration

Certified Engineering Geologist – Oregon
Registered Geologist – Oregon
Level 2 Technician – SPRAT (Society of Professional Rope Access Technicians)

Societies

Member, Association of Engineering Geologists, Oregon Section

Professional Career

2006-present Landslide Technology, Portland, Oregon; Project Geologist
2005-2006 Northwest Geotech, Inc., Wilsonville, Oregon; Geologist

Relevant Experience

Mr. Koslofsky has over nine years of engineering geology experience throughout the western United States. He specializes in rockfall hazard evaluation and analysis, rope access techniques for design mitigation, and construction assistance. Representative projects include the following:

Going-to-the-Sun Road (GTSR), Rockfall Hazard Rating System Implementation, Glacier National Park, West Glacier, Montana. As Field Geologist, assisted in the implementation of the Rockfall Hazard Rating System along Going-to-the-Sun Road (GTSR) in Glacier National Park. Used RHRS to evaluate over 120 rock slopes and assign a priority score to them. Assisted in the design of rockfall mitigation along 20 rock slopes along GTSR. Recommended mitigation options included shotcrete, scaling, PUR injection, bolting, and trim blasting.

I-15 Rockfall Mitigation Design, Helena to Great Falls, Montana. Field Geologist assisting in the investigation, instrumentation, and design of rockfall mitigation measures for 15 sites along a 30-mile stretch of Interstate-15. Recommended mitigation options included blasting, scaling, bolting, barriers and mesh. Performed instrumentation of crackmeters.

US 75 Rockfall Hazard Rating System Implementation, Stanley, Idaho. Field Geologist assisting with the implementation of the Rockfall Hazard Rating System along a 0.75 mile stretch of US 75. Work tasks included conceptual design with several mitigation options along the historic and scenic roadway for Western Federal Lands Highway Division. Conceptual designs included options for low aesthetic impacts, cost estimates for labor and materials, and annotated photographs of each slope section with mitigation options shown on the photos.

Banks-Lowman Highway Rockfall, Banks, Idaho. Field Geologist assisting in the design of mitigation options for numerous rockfall and debris flow sites along the Banks-Lowman Highway in Idaho. Work tasks included mapping and collecting structural data, and collecting rock and soil samples for determining mitigation options. Utilized rope access techniques and man-lifts to access the slopes. Mitigation options for

rockfall areas included mesh, blasting, scaling, rock bolts, attenuators, barriers, fences, and realignments. The debris flow areas had mitigation options that included catchments and fences.

Diablo Dam Rockfall Mitigation, Diablo, Washington. Field Geologist responsible for providing full-time construction control services for rockfall mitigation of the slope adjacent to the Diablo Dam Powerhouse as Owner's representative. Work tasks included construction oversight for placement of temporary rockfall protection, hazard tree identification and removal, heavy scaling to remove unstable rock, rock bolting and cable lashing to stabilize large blocks and the installation of both attenuator and post and brace rockfall fences to control the descent of smaller blocks.

Pelton Dam Tailrace Rock Slope Stability, Madras, Oregon. Field Geologist responsible for structural mapping, investigation, and assisting with conceptual mitigation design for the rock slope that is below the Pelton Dam spillway. Several slabs had begun to topple out below the spillway causing undermining, loss of support for the spillway which potentially may impact the hydraulics of the tailrace. Site required rope access techniques to investigate and gather structural and geologic data for mitigation design.

Swift Powerhouse No. 1 Slope Mitigation, Cougar, Washington. The project involved an emergency response and final mitigation to a debris flow that impacted the Swift Powerhouse No. 1. As Field Geologist, Mr. Koslofsky was involved in the construction observation for mitigation of the slope to prevent further raveling by installing a nailed-Tecco mesh. Utilized difficult rope access techniques for QA/QC verification that all soil nails achieved design loads, observed repairs to rockfall fence, debris removal from slope, proper placement and installation of Tecco mesh and top-rope support system.

Washougal River Road Rockfall, Washougal, Washington. Field Geologist for the investigation and evaluation of a previously mitigated rockfall. A bolted boulder fell out and damaged a Tecco mesh fence. Rope access techniques were used to evaluate and check the tension and condition of over 50 rock bolts. Assisted in repair recommendations for the damaged mesh section and area where the new rockfall had occurred.

Biscuit Rock Access Road Rockfall, Estacada, Oregon. The project involved a landslide induced rockfall that closed the access road between two Portland General Electric dams. As Field Geologist, Mr. Koslofsky installed several rockfall monitoring instruments using rope access techniques to access the monitoring locations. Monitored and kept records of rockfall and landslide debris cleanup, tree removal and installation of a gabion rockfall barrier for protection of the down slope road and the fish passage canal from future rockfall. Prepared daily construction reports.

Yale Powerhouse Rock Slope Instrumentation, Cougar, Washington. Field Geologist responsible for mapping, investigation and instrumentation of a massive, unstable rock block threating a powerhouse. Rope access techniques were used to investigate the stability and install instrumentation such as crack and convergence meters. Investigation included drilling test holes to determine thickness of block and extent of open joint exposed on downstream edge. Observed rock bolting along base at differential weathering surface to stabilize base of block. Assisted in design of final mitigation.

SH-55 MP 82.5 Slope Mitigation, Banks, Idaho. Field Geologist assisting in the investigation and design of mitigation options for a section of highway prone to shallow debris flows and raveling. Utilized rope access techniques to investigate the face and obtain structural information.

KEVIN R. SEVERSON, PROJECT ENGINEER

Education

M.S. in Geotechnical Engineering, Oregon State University, Corvallis, Oregon
B.S. in Civil Engineering, Oregon State University, Corvallis, Oregon

Registration

Civil Engineer – Oregon, Washington
Level 1 Technician – SPRAT (Society of Professional Rope Access Technicians)

Societies

Member, American Society of Civil Engineers – Oregon Section (ASCE Oregon)
Member, Society of American Military Engineers

Professional Career

2010-present Landslide Technology, Portland, Oregon; Project Engineer

Relevant Experience

Mr. Severson has worked for Landslide Technology as a Geotechnical Engineer since 2010. Representative projects include the following:

I-15 Rockfall Mitigation Design, Helena to Great Falls, Montana. As Field Engineer, performed structural mapping while utilizing rope access techniques to instrument five locations with crackmeters for long-term monitoring. Performed visual reconnaissance of potentially hazardous rock blocks and evaluated construction access while on the slope. Evaluated crackmeter data to determine seasonal performance of instrumented rock blocks.

Merwin Dam Rockfall Stabilization, Woodland, Washington. Field Engineer responsible for utilizing rope access techniques to map and evaluate a rock slope to determine the need for mitigation during construction of a new fish passage facility at Merwin Dam. Duties included mapping and interpretation of structural data and research of historical documents and photos. Provided field inspection of drilling and installation of rock anchors. Post installation stressing verified the location of bond zones and rock anchor capacity. Stressing was performed per Post Tensioning Institute specifications.

Ross Powerhouse Emergency Rockslide Mitigation, Diablo, Washington. Field Engineer responsible for daily monitoring and inspection activities of rockfall mitigation work. Work tasks included inspecting and documenting rock scaling and rock bolting activities, including drilling, installation, grouting, and tensioning. Inspection activities often required rope access techniques. Project reports and quantity updates were submitted to the Owner and project managers daily.

Yale Powerhouse Rock Slope Evaluation, Cougar, Washington. Performed rope access techniques to investigate a large rock block positioned above a hydroelectric powerhouse. Cross sections were generated for RocFall analysis using a laser range finder. Key rock blocks and suspect joints were instrumented with convergence meters, tilt meters, and crackmeters. All of the instruments were connected to dataloggers.

AINE E. MINES, STAFF ENGINEER

Education

M.S. in Geotechnical Engineering, University of California at Berkeley, Berkeley, California
B.A. in Earth and Planetary Sciences, Washington University in St. Louis, St. Louis, Missouri

Registration

Engineer-in-Training (E.I.T.) – Oregon
Geologist-in-Training (G.I.T.) – Oregon
Level 1 Technician – SPRAT (Society of Professional Rope Access Technicians)

Professional Career

2011-present Landslide Technology, Portland, Oregon; Staff Engineer

Relevant Experience

Ms. Mines has worked for Landslide Technology as a Geotechnical Engineer since 2011. Representative projects include the following:

Clearwater Junction (Hwy 93) Geotechnical Explorations and Evaluation, Montana. Field Engineer responsible for providing geotechnical exploration services on difficult access slopes in Swan Valley, Montana in preparation for a proposed roadway improvement project. Coordinated with MDT personnel, logged borings, developed final boring logs, and assisted in writing the final report on the evaluation results.

Alaska Statewide Geotechnical Asset Management Program, Alaska. As Field Engineer, assisted in the implementation of the statewide Geotechnical Asset Management (GAM) Program, which conducted field inspection and ratings for approximately 750 unstable slopes throughout the state. Performed ratings and GIS mapping in the field, and coordinated with AKDOT&PF maintenance personnel to collect necessary information on maintenance history and past unstable slope activity. Searched AKDOT&PF bid tabs for data to help develop valuation models for state material sites. Developed condition state/intervention cost correlations for unstable rock slopes. Coordinated with other state agencies to acquire data needed to develop additional slope condition/intervention cost correlations for unstable soil slopes.

Ketchikan North/South Tongass Highway Geotechnical Asset Management Research Project, Alaska. Field Engineer assisting with the Tongass Corridor GAM research project, which will be implemented statewide in AKDOT&PF's final GAM program. Conducted field inspections and ratings for approximately 100 retaining walls. Developed field rating system for inventorying culverts and rating culverts, and tested this system in the field. Coordinated with AKDOT&PF maintenance personnel to collect necessary information on maintenance history of retaining walls and culverts. Conducted data analysis of retaining wall ratings to assist in deterioration curve development. Wrote initial draft of deliverable interim report.

Oak Terrace Rockfall, Lake Oswego, Oregon. Field Engineer responsible for assisting in the development of a rockfall mitigation system utilizing rock dowels and draped Tecco mesh. Participated in field investigation, design work, and development of plans and specifications. Provided construction observation assistance.

COLLIN N. MCCORMICK, STAFF ENGINEER

Education

M.S. in Geotechnical Engineering, University of Washington, Seattle, Washington
B.S. in Civil Engineering, Oregon State University, Corvallis, Oregon

Registration

Engineer-in-Training (E.I.T.) – Oregon
Level 1 Technician – SPRAT (Society of Professional Rope Access Technicians)

Professional Career

2013-present Landslide Technology, Portland, Oregon; Staff Engineer

Relevant Experience

Mr. McCormick has worked for Landslide Technology as a Geotechnical Engineer since 2013. Representative projects include the following:

Alaska Statewide Geotechnical Asset Management Program, Alaska. As Field Engineer, assisted with the implementation of the statewide Geotechnical Asset Management (GAM) Program for 750 slopes in the Alaska State Highway System to provide AKDOT&PF with data on the overall performance and condition of soil and rock slopes. Performed slope ratings and GIS mapping in the field for rockfall and landslide hazards and coordinated with AKDOT&PF maintenance crews to gather information on slope history and maintenance intervals. Assisted in the development of GAM deliverables including mapping and analysis of the slope rating data collected in the field.

I-15 Rockfall Mitigation Final Design, Helena to Great Falls, Montana. Field Engineer responsible for performing structural mapping, rockfall modeling, and kinematic analyses for fifteen high hazard sites along Interstate 15 corridor between Helena and Great Falls Montana. Assisted in final design of rockfall mitigation measures for six sites including development of final plans and specifications.

Unstable Slope Management Program for Federal Lands, Gifford Pinchot NF, Washington. Field Engineer assisting with the implementation of the Unstable Slope Management Program (USMP) rating system for 125 sites along rockfall and landslide prone roadways in the Gifford Pinchot National Forest. Assisted Western Federal Lands Highway Division (WFLHD) in the development of the USMP rating forms through meetings and coordination with Federal Land Management Agency representatives. Assisted in development of USMP deliverables including data analysis and mapping.

Rockfall Analysis for the HCRH Trail, Interstate 84, Wyeth to Starvation Creek, Oregon. Performed rockfall modeling and assisted in development of conceptual rockfall mitigation for 10 sites along a proposed multi-use recreation path on the south side of the Interstate 5 corridor in the Columbia Gorge. Evaluated potential effectiveness of several rockfall mitigation alternatives using computer rockfall simulations.

Yale Powerhouse Rock Block Removal, Yale, Washington. Field Engineer responsible for providing construction observation services using rope access techniques during scaling and rock bolting operations. The project involved removal of a large rock block above the powerhouse at a dam facility. Rock removal techniques used included hand scaling, air bags, and use of expansive grout.